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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

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The Registered Office and Laboratories of the B.C.I.R.A. at:—
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Telephone: Central 1885. Telegrams: CIRA

The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*)

Forthcoming Events

MARCH 13

Institute of Metals (Swansea Local Section):—Meeting at the Y.M.C.A. at 6.15 p.m. Discussion on "Rolling," to be opened by Prof. L. Taverner.

MARCH 14

Institution of Welding Engineers:—Meeting at the Institution of Mechanical Engineers, London, at 7.45 p.m. "The Collation of Research and Application for Welded Fabrications," Paper by H. W. Hawkins.

Institute of British Foundrymen

MARCH 10

Lancashire Branch:—Meeting in the Engineers' Club, Albert Square, Manchester, at 4 p.m. "Some Aspects of Non-Ferrous Founding," Paper by A. Logan.

MARCH 14.

Birmingham, Coventry and West Midlands Branch:—Meeting at the Chamber of Commerce, New Street, Birmingham, at 7.30 p.m. "A British Foundry School," Paper by J. G. Pearce.

London Branch:—Meeting at Charing Cross Hotel, W.C.2, at 8 p.m. "Potentialities of Cast Iron," Paper by A. B. Everest.

MARCH 16

Sheffield and District Branch:—Meeting, Grand Hotel, Sheffield, at 7.45 p.m. "The Use of Sodium Carbonate in Iron and Steel Works," Paper by N. L. Evans.

MARCH 17

Wales and Monmouth Branch:—Annual general meeting at University College, Cardiff, at 6.30 p.m.

MARCH 22

Birmingham, Coventry and West Midlands Branch:—Meeting at the James Watt Memorial Institute, Birmingham, at 7.30 p.m. "Plastic Moulding."

MARCH 24

East Midlands Branch:—Annual general meeting at Loughborough College at 6 p.m. Short Paper competition.

East Midlands Branch (Lincolnshire Section):—Annual general meeting at Technical College, Lincoln, at 7 p.m.

Lancashire Branch (Junior Section):—Meeting at College of Technology, Manchester, at 7 p.m. "Making a Chemical Pan," Paper by H. Meadowcroft.

Newcastle-upon-Tyne and District Branch:—Meeting, Neville Hall, Newcastle, at 6.15 p.m. Annual general meeting. Lecture: "How London's Tube Railways are Made."

Wales and Monmouth Branch:—Meeting at Llanelly. "Some Practical Moulding Problems," Paper by E. Longden.

A New Society

Elsewhere in this issue we report the creation of a committee which is to study the possibility of the creation of a society destined to advance the science and practice of vitreous enamelling. The society may undertake certain commercial activities such as the adoption of a Hall Mark for materials which are genuinely enamelled by the vitreous process as against the stove-enamelled ware. In any case, commercial organisation provides a channel for co-operative action for technical activities.

Up to now, the enamelling industry has largely used the Institute of British Foundrymen as its medium for the publication of its researches and developments. We remember the abortive efforts we made to obtain articles on this subject ten or twelve years ago. Credit must be given to the Americans for breaking down the barrier, which converted the enamelling process from a "black-magic" art to a scientific basis. The contributions to our columns in recent years by Marshall, Kent, England, Bradshaw and others have materially advanced the technique of the subject, but much still remains to be done in the direction of colouring, costing, furnace work, provision of suitable irons, support of work in the furnaces, perretts, dust extraction and correlation with shot blasting.

Obviously the foundry industry will be extremely interested in the development, as several firms manufacturing iron castings are represented on the Founding Committee, whilst the British Cast Iron Research Association have investigations in progress on the subject of enamelling. It might be thought that this subject could very well be handled by the Institute of British Foundrymen, but the enamelling industry has thought it wise to include in their activities the enamelled-sheet and hollow-ware trades, which are definitely outside the scope of the Institute. We are sure, however, that if a technical association is the outcome of the Founding Committee's deliberations, then the Institute will give all the help it can by co-operative effort.

The Use of Cast Iron

We have from time to time bewailed the lack of information respecting the progress of the industry, in which we are keenly concerned and which provides us with bread and butter. While we publish the imports and exports of cast-iron products and their values, the much larger and much more important internal trade in cast iron is not documented at all, output, types of castings made, value, number of men employed and so forth.

An instructive example is given by a recent questionnaire circulated to our friends who are engaged in welding. To assess the progress of this process an attempt is made to find out such salient facts as representative products in which the process is used, and whether it is supplanting any other process, numbers of men employed, whole and part time, whether the process is likely to increase or decrease, whether any special developments have occurred during the past few years, the extent to which it is superseding other forms of construction, and the extent to which it has been superseded by other forms of construction. Such data in respect of founding would be of enormous value, because in a few years it would be possible to see what differences were existing between the curves obtained and those normally expected on account of cyclical variations in trade. If the query be raised as to why this is not done (and it is essentially a matter for a trade association), the answer is that no single body exists with sufficient authority or sufficiently representative character to do it. It could scarcely be undertaken on a partial basis, for one section of the industry, or for a proportion only of the producers in one section. It must be for the trade as a whole, and sooner or later, in its own interest, the trade must undertake it.

XUM

Centrifugally-Cast Pipe

IMPROVED GRAY-IRON STRUCTURE WITHOUT CHILL

According to "The Iron Age," a notable development in the manufacture of deLavaud centrifugally-cast pipe has been achieved by the United States Pipe & Foundry Company. It amounts to applying powder to the inside of the permanent mould of the casting machine in such a way that not only is chilling of the iron prevented but instead a grain structure is obtained that imparts increases in both strength and ductility over the former practice. The new process has been in commercial operation for something like a year, and the centrifugally-cast pipe now made is known as super-deLavaud pipe. The inherent difference in the previous standard deLavaud product and the super-deLavaud is evidenced in fracture tests. In the case of the previous standard product, cracks developed longitudinally in the pipe and bursting was accompanied by a large number of fragments. Cracks in the case of the super-deLavaud pipe extend irregularly and for short distances from a centre with little opportunity for fragmentation on final fracture.

The central feature of the new process appears to lie not merely in the use of a suitable powdered material to check the rapid flow of heat from the molten iron to mould, but in the method of applying it. Any one of several out of a large number of powders will perform satisfactorily, it has been found, but much investigation and experimenting was carried on before arriving at an effective and commercially-feasible method of getting the powder to the work. A predetermined and closely-measured quantity of the powder, depending on diameter and length of pipe to be made, is delivered to the mould for every cast. The container for the powder is a specially-designed chamber mounted on each casting machine. A small adjustable vane serves to divert from the container as it revolves the desired amount of powder, after the fashion that a knife gate at a given point removes from a travelling belt conveyor, part of the material being carried on the conveyor. The powder released from the container is caught by the inducing action of a stream of compressed air running through a pipe to which the powder outlet is connected. The pipe runs alongside the molten iron runner or trough of the casting machine. Near the end of the iron runner, the air pipe terminates in a nozzle designed to deposit the mixture of air and powder on the mould wall. The iron leaves the runner in a stream about 3 in. wide. As the pipe mould is revolving and at the same time receding from the runner end, at the beginning of casting, the machine carriage carrying the mould entirely encloses the iron runner; the outer end of the pipe is that first formed, so that when the pipe length is completed (the carriage with its mould has moved away from and has uncovered the runner), the molten iron stream covers the path of a helix. The longitudinal movement of the carriage with its mould and the rotary speed of the mould are such that the molten iron is held to an even thickness against the mould by the action of centrifugal force, and there is quick solidification into a complete pipe length.

The position and shape of the nozzle is such that the powder is being deposited on the mould just before the molten iron reaches it. It would appear, however, that the use of a carrier gas (in this case, compressed air), for depositing the powder at the proper point and at the exact moment is essential. Besides transporting the powder from container to nozzle, the air performs the function of a heat insulator. In the very small fraction of a second between the impinging of the powder on the mould wall and the coming on the same spot of the molten iron, the air has had little or no chance to escape from the mixture. Thus there is a thin film of aerated powder with the air entrained in it serving as an insulator against the chilling effect of the mould. The shape and form of the nozzles constituted also an experimental problem of considerable magnitude. The final shape is that of a cone with numerous circular perforations so sized and spaced that the cross-sectional area of the cone interior at any point looking toward the apex is always equivalent to the combined areas of the orifices beyond that point.

Physical Properties

To prove the quality of the super-deLavaud pipe, a series of impact tests were observed. Tensile tests indicated equal ultimate strength for both the standard and the super pipe material, but the stress-strain curves showed 62 per cent. greater deformation before failure for the super product, that is, 62 per cent. greater elongation or ductility. Pieces of the pipe material were readily cut from the super-product "as cast" by means of a hack saw, showing it possessed the easy-machining properties of gray iron before annealing. The impact tests were conducted with full lengths of pipe subjected to a maintained water pressure of 65 lbs. per sq. in. A 50-lb. hammer was dropped on the pipe in the middle of a 24-in. span. The weight was dropped first from a distance of 6 in., and the distance was then successively increased by increments of 2 in. The height was recorded when the first signs of cracking appeared, then the height when a leak became noticeable, and finally the height when there was sufficient opening for a spurting of water, a condition designated as failure. The results of some tests with 6-in. pipe were in part as follows: With the standard deLavaud pipe, unannealed, failure occurred with a drop of 1.16 ft. The standard pipe annealed required drops of 1.83 ft. to bring failure. The super-deLavaud unannealed did not fail until a height of 1.88 ft. was reached, while the super-product annealed did not show failure until the drop was 3.94 ft. In the case of the standard pipe, when cracking began, it was generally a single hair line developing rather rapidly in opposite directions from the point of the hammer blows. With the super-product there was a group of short cracks more or less irregularly radial from the point receiving the hammer blows.

Catalogue Received

The "Rapid" Steel, Iron and Metal Reckoner. Published by Messrs. Gall & Inglis, 13, Henrietta Street, London, W.C.2. Price 1s. 6d. net.

The cost of this 70-page booklet is so low that, if usefully handled for but a quarter of an hour by a high-priced workman, its cost is saved. We do not care for the way in which decimals and fractions are mixed up in certain tables. For instance, we are informed that 0.1¼ lbs. equals 2 ozs. We would have preferred 0.125 lbs.

GENERAL REFRACTORIES, LIMITED, of Sheffield, have announced their acquirement of control of George Turnbull & Company, Limited, fireclay and ganister mine-owners, of Bonnybridge, Scotland, manufacturers of the celebrated "Dykehead" firebricks. The works of the company are well equipped, and are conveniently situated, between the ports of Grangemouth on the east and Glasgow on the west, to assist in supplying the heavy export demands of the controlling company. George Turnbull & Company, though always profitably conducted, have not for several years been fully employed, and it is anticipated that General Refractories, Limited, whose sales organisation covers the whole of Europe, will benefit considerably from the acquisition of this further source of supply.

Random Shots

When reading market reports and commercial comments, "Marksman" has often been brought to the verge of tears at the thought of those unfortunates whose line of destiny has led them into the habit of putting down on paper week by week accounts, more or less truthful, of what is going on in the world of business. Two, or even three, tears might well be shed for these hard-working scribes, whose path in life is about as smooth as a nutmeg grater (q.v.). True, things occasionally happen which make for lively comment and give the lads a chance to spread themselves, but for the most part theirs is a bitter and anguished existence.

* * *

"Marksman" wonders how the weekly column would read if restraint were abandoned and the naked truth set down in stark and staring capitals. Something like this perhaps:—"There is a certain dreadful sameness about the pig-iron market which makes it impossible to put down anything likely to interest the reader of even moderate intelligence. As this column has been trying to point out for weeks past, trade is improving, and it will not get any worse or any better because of what we say about it. The recent increase in price was a nice smack in the eye for those know-alls who had been kidding themselves that no change would be made, and probably the buyers who neglected the advice proffered in our pages a few weeks ago will get it in the neck from their directors. Serve them jolly well right, too, the stiff-necked griffins. Export business in pig-iron is pretty putrid, but what else can you expect when the exchanges keep jumping about like a lot of fleas. Well, so long, kiddies, and look out for more fun next week from Uncle Parker."

* * *

Now keep your sets tuned in, for "Marksman" is going to give you some idea of what, in his opinion, might happen to a report on the scrap market in similar circumstances:—"Is old iron scarce? Oh, boy, I should say it was, down in the Midlands; why, they have stopped throwing saucepans at each other because somebody said that was cast iron and would fetch a better price. Hidden reserves of old iron are coming to light on suburban back gardens as spring digging progresses, but most of this is thrown over the neighbour's fence and will not be available for the foundries. N.B.—The thrower is going on as well as can be expected; they tell me it was some scrap!"

* * *

The non-ferrous metal markets might equally well be reviewed with brutal frankness. "Copper is still suffering from an attack of fluctuations and the way the price keeps bobbing about from day to day is perfectly sickening. Copper buyers are on the whole a chicken-hearted lot, and if they buy a few tons one day, they sit around looking at each other for a month afterwards, shivering with apprehension. The Americans are still trying to make up their minds about a code, but there is no particular hurry, as they have only been talking about it for nine months or so. Uncle Sam's the boy for hustle! All the commercial bigwigs keep on saying that copper is cheap, but none of them has enough pluck to lift a few thousand tons out of the American dump and so set the ball rolling. Is the market likely to go up? Ask me another! Blowed if I know.

MARKSMAN.

Vitreous Enamellers to Organise

FOUNDING COMMITTEE APPOINTED AT BIRMINGHAM

A meeting of representatives of various firms engaged in or connected with the vitreous porcelain enamelling trade was held at the Birmingham Section of the British Industries Fair on February 28, in order to consider the desirability of forming an organisation for this section of the metal industry.

There was a good attendance, including firms interested in gas- and electric-stove manufacture, the hollow-ware and sign trades and firms engaged in enamelling for the cast-iron and sheet-metal trades generally.

Mr. W. H. Whittle (Protector Lamp & Lighting Company, Limited, Manchester) was voted to the chair, and at the outset expressed gratification at the encouraging attendance, although it was difficult to fix a date and time to suit everybody, as other meetings were taking place the same day. He thought it was a good thing for the trade to get together, and an advance would be made if they could decide to form a Committee so that steps could be taken to form a proper organisation.

Enamelling was by this time by no means a small trade, and, as they all realised, it was a highly-technical business. It was one of the few technical trades not yet represented by some society or institution; and even if nothing substantial were to come as a result of that gathering, he ventured to say that something would have been gained by getting the members of the industry together at one or two meetings, as it provided an opportunity for them to exchange ideas and perhaps do a good turn one to another. By meeting in a friendly atmosphere they could discuss their particular individual problems. However, the main idea at the moment was to form an organisation.

A Highly-Technical Industry

Mr. J. T. Gray (Messrs. J. Gray & Sons, Limited, London), who organised the gathering, was then called upon, and said this informal meeting had been arranged so that a preliminary step could be taken, if considered advisable, by the appointment of a Committee to draft a constitution for the proposed Society. In that way they could get to work and in due course form an organisation for the trade. No agenda or special arrangements had been made, it being thought best to get the members together and allow a free discussion on the object in view.

Then, if thought fit, a Founding Committee could be appointed to meet in Birmingham, London, or wherever it was deemed most convenient, or do the most good. He thought it necessary at this stage to mention that he and his firm had been criticised because of their activities in supporting the proposal, and it had even been suggested in one quarter or another that they were undertaking this work from a sales propaganda point of view.

But to this he must say, most emphatically, that nothing was further from his thoughts. His firm were in the enamelling trade, it was true; and, like others whom they were extremely glad to welcome there, they realised that it was a highly technical trade, and also about the only one which had not a society of its own. Therefore his firm was out to do all it could to help the industry, and this he considered they were doing, by assisting with the preliminary work of forming an organisation for the enamelling trade, and to assist it when it was established.

However, as supply engineers to the enamelling trade his firm felt that none of its members was in a position to hold office in the new organisation, and in this respect he considered he was expressing the view of all the leading firms interested in supplies to the trade.

He thought they would appreciate the explanation which he had made, and he might add that it was purely in deference to the wishes of a number of leading enamellers—who time and again, when they had met at meetings of other societies such as the Institute of British Foundrymen, had suggested that it was desirable to form an enamellers' society—that he had undertaken to do the preliminary work, because, after all, somebody had to start the movement if it was to be established.

Sectional Organisation

There had been, as the Chairman well knew, attempts made on various previous occasions to come to some kind of arrangement among enamellers. The sign section had met on at least one occasion, and the hollow-ware people had also met, to see if something tangible could not be done.

Possibly failure to form a society on those occasions had been due to the fact that those gatherings represented only one branch or other of the enamelling industry, and he thought he was expressing the general view when he said that in the present proposal to form a society or institution every branch of the enamelling industry was envisaged.

If this were done and the organisation became a kind of parent body, then the hollow-ware people, if they had any points which they wished to discuss among themselves either on commercial or technical lines, could perhaps form themselves into a section or committee of the main body. The same plan could be adopted, if desired, on the part of the sign trade, the gas-stove enamelling trade, the jobbing trade, and so on.

He believed they would agree that it was high time the trade formed an organisation, and most of the important firms, unable to be present, had expressed themselves interested in the movement, and, as Mr. Whittle had remarked, it would be to the advantage of the trade and conditions operating in it. For one thing, it would create goodwill and encourage co-operation. Mr. Gray next mentioned that the Chemical Club in London would in all probability welcome members of this new society as members of their club. In this way the members of the new society could use the Chemical Club as their London headquarters, to meet and discuss their business.

Hall-Marking Enamelware

Another important point which might be considered if the proposal were adopted was the introduction of a badge or transfer to be affixed to each piece of enamelware as a kind of hall-mark, guaranteeing it to be of vitreous porcelain enamel, as distinguished from synthetic paints.

A further matter which might be decided was in relation to technical Papers. Now some people seemed to have got it into their minds that if an institution was formed and they became members, they might be called upon to prepare addresses and so divulge their trade secrets and technical knowledge which it had taken them a long while to acquire. But that conclusion was not justifiable and was not generally held.

There were other angles of this particular point. They heard of people who had bought what was generally considered to be inferior raw materials—feldspar, for instance—but they had been able to use these materials successfully. The men who had done this might feel disposed to read a Paper before the Society, explaining how they had successfully overcome the difficulties previously experienced with these materials. Of course, this was only an indication of what might be done.

However, these matters need not engage their attention now, as it would be purely a matter for the men who had carried out such work as this to decide whether they were prepared to give the results of their work in the form of a Paper, and, on the other hand, of course, the Society would decide whether such Papers should be read.

They would have to consider whether the organisation was to be a purely technical one, or be concerned with the commercial aspect of the trade; whether it should embrace both sides.

Objects Disclosed

He had been told by some that the Society must be purely technical and scientific in its scope, but this, to him, was not essential, because, after all, technical institutions could not exist were it not for commerce. Although the leading chemists in industry were not directly or primarily concerned with sales, it was their object to produce something which had a commercial value and use, and it was the duty of others concerned in industry and commerce to commercialise their discoveries and products.

That was the factor at the back of the minds of all those who directed research work. It was said by some that commercialism could not be linked up with the scientific or technical side of an industry, which he considered was not quite correct. Time and again it had been declared that servicing and supplying could not be mixed with consulting work; but his firm had proved this view to be wrong, as they were doing both, and doing both successfully.

Concluding, Mr. Gray said he thought he had expressed what was in the minds of those who had invited him to start the ball rolling. If a Society could be formed, he had received intimations that a number of firms who were definitely interested, and others who were "sitting on the fence," so to speak, would come forward as members.

A Founding Committee Formed

The Chairman, having invited questions, said he thought the best plan at that stage would be to ask for a show of hands as an indication of the feeling of the meeting as to whether a society should be formed or not. They could, if it were decided to go ahead, proceed to the appointment of a Founding Committee, which would go into the question of a constitution and obtain data, and so provide a definite agenda for the following meeting called to bring the organisation into being. Nearly all present voted for a committee being formed, a few refraining as not being empowered to vote and attending in order to report back to their firms. The chairman then asked for suggestions as to the gentlemen who might be asked to serve on this committee.

Mr. J. T. Gray remarked that it would be a good thing if they could secure on the committee representatives of the different sections of the trade; say the stove, range, sign, hollow-ware, jobbing enamellers, and so on.

Mr. W. S. Grainger (Stocal Enamels, Limited, Burton-on-Trent) expressed readiness to be associated with the movement, especially as practically every other industry or branch of industry had its own society to consider its various problems and enable its members to meet socially. He endorsed the view that every section of the industry should be represented, and he was sure the jobbing enameller and the sign trade would welcome the idea. He would therefore be pleased to render what assistance he could.

The New Outlook

Mr. W. Todd (Parkinson Stove Company, Limited, Birmingham) stated that there was no question that an organisation was needed, and he thought that everyone concerned in the industry ought to be prepared to state their case quite frankly and freely, because the time had long since passed when enamelling was regarded as "black magic" and handed down from generation to generation. He himself was prepared to serve on any committee appointed with

XUM

a view to inaugurating an organisation. The question of where the Founding Committee could meet was not an easy one, seeing that members came from London, Birmingham, the Midlands generally, the North of England, and Scotland, but it was not unsurmountable. He suggested that it was a most opportune moment for establishing some such body, and the exchange of views in a friendly way should be of considerable benefit to trading conditions. In fairness to Mr. Gray and his preliminary work, it might be remarked that all pioneers had to face some obstacles or criticism, and he thought they would agree that Mr. Gray was to be congratulated on making this initial effort.

All of them would, of course, dismiss any suggestion that he had ulterior motives in undertaking this duty as being unworthy of notice. Moreover, he thought they need have no fear that the gentlemen who had tried to start this movement were actuated by other than good and unselfish motives.

A Ready-Made Hall Mark

MR. B. B. KENT (Sterling Manufacturing Company, London) said that his firm had done a little towards backing up the proposal. They happened to be members of the Porcelain Enamel Institute of America, and had the permission of that body to register their sign in England, on the express condition that it was handed over to any society which might be formed here. His company had registered the sign, so that it was now available for use in this country, but most probably the Enamellers of Great Britain would prefer to design their own badge or sign.

MR. J. H. GRAY, JUN., supported the view that the organisation should embrace every section of the trade and that the Committee should be representative, not only of each branch of the trade but also of all parts of the country. He explained that if they could form a Committee composed of representatives of, say, Scotland, the North of England, the North Midlands, Birmingham, and London and the South, such a Committee would be in the best interests of the industry.

The CHAIRMAN mentioned that, as to the Founding Committee, it would exist for a limited time only, its duty being to draft a scheme to put forward at a further meeting of members of the trade. When this was done and the society was formed, officers would be elected and another Committee appointed to carry on, and the commitments of the Founding Committee would then cease.

MR. A. ENGLAND, M.Sc. (Blythe Colour Works, Cresswell, Stoke-on-Trent), said he quite agreed with Mr. Gray that those concerns which were accessories to the enamelling trade—several names of gentlemen associated with them had been mentioned—would be only too glad to help, because although they did not produce enamelled goods, they were directly interested in their manufacture, and in support of Mr. W. Todd's earlier remarks, he mentioned that some time ago he was giving a lecture* in Falkirk on vitreous enamelling in which he said that enamelling was no longer regarded as the black art of the ancients. He considered it would be wise to leave the accessory firms off the Committee, but they would do all they could to help forward the movement in other directions.

Personnel of Committee

MR. T. CHAMBERS (Messrs. Beech & Chambers Enamels, Limited, Birmingham) asked if it was desirable to form a Founding Committee and omit such men as Mr. Gray and Mr. England, or to exclude them from the Institute when formed? Would not they help to widen the scope of the organisation, and surely they required the enamel manufacturers to join with them? They had a vital interest in the industry, and ought to be of great assistance. The enamel manufacturers and service engineers dealt with an aspect of the trade which they who handled enamels had little or much less knowledge of.

The CHAIRMAN thought the point worthy of consideration, and it might be usefully discussed, as certain matters which arose would no doubt be discussed, by the Committee to be appointed. There seemed to be a good deal in what Mr. Chambers advocated. A vote, however, showed divided opinions.

MR. W. TODD said he was against the suggestion, because if representatives of suppliers were holding office it might cause friction, which they wanted to avoid, especially at the start. However, he thought the situation could be met by the Founding Committee ascertaining and taking advantage of the views which any of the suppliers might care to put forward. He thought they might invite suppliers to send in suggestions to the Founding Committee, who would bring forward a draft constitution and embody such recommendations or suggestions as seemed desirable. He considered that gentlemen representing suppliers were well advised to remain outside the Founding Committee at the inception of the movement, although they welcomed their co-operation.

After further friendly discussion, the CHAIRMAN thought it would be as well to adopt the attitude taken by Mr. Todd on the matter, and instead of appointing suppliers on the Committee, to invite suggestions from them.

MR. GRAY replied to the effect that he considered he was expressing the view of the accessory firms in stating that they would be only too happy to give every possible assistance in the manner indicated.

The CHAIRMAN announced that Mr. J. F. Barry (of 26, Wharton Street, London, W.C.1) had kindly offered his services as acting-secretary to the Founding Committee, and that he would communicate with the trade generally and also with the members of the Founding Committee regarding the next meeting, which it was decided to hold on Friday, March 9, at 2.30 p.m., at 3, Clifford Street, London, W.1.

MR. J. T. GRAY said that Mr. Barry would be acting-secretary only until such time as the organisation was formed, when it would, of course, be necessary for him to withdraw.

The CHAIRMAN then thanked Mr. Gray on behalf of the meeting for his work, and congratulated him on the success so far achieved, and said that the Founding Committee was looking forward to the support of every firm interested in enamelling, as the constitution of such a society could only have a beneficial effect on every member of the industry.

The meeting was then closed, and subsequently most of those present at the meeting remained for an informal chat. The Committee appointed consists of the following:—

Mr. W. H. Whittle (Protector Lamp & Lighting Company, Limited, Eccles, Manchester), Chairman.

Mr. W. S. Grainger (Stocal Enamels, Limited, Burton-on-Trent).

Mr. W. Todd (Parkinson Stove Company, Limited, Birmingham).

Mr. J. H. Coupe (Messrs. Belling & Company, Enfield).

Mr. B. B. Kent (Messrs. Sterling Manufacturing Company, London).

Mr. W. Noake (Patent Enamel Company, Birmingham).

Mr. H. Whitaker (Rustless Iron Company, Limited, Keighley).

Mr. C. Lee (Messrs. Farmer & Chapman, Limited, Bilston).

* FOUNDRY TRADE JOURNAL, January 4, 1934, page 3.

Blast Conditions in Cupolas

In the "Technische Mitt., Krupp," H. JUNGBLUTH and P. A. HELLER give a nomogram and describe a slide rule for working out the relations between the gas composition, coke charge, furnace capacity and volume of blast on cupolas from an analysis of the waste gases.

Imported Chain or Pulley Blocks

APPLICATION FOR MARKING ORDER

The Standing Committee (General Merchandise) appointed by the Board of Trade under Part II of the Merchandise Marks Act, 1926, and presided over by Sir Hubert Llewellyn Smith, heard an application at the Board of Trade Offices, Westminster, on Monday, February 26, for a Marking Order in respect of imported chain or pulley blocks, whether imported complete or in parts.

The applicants were Foundry Equipment, Limited; Charles Willetts, jun., Limited; Herbert Morris, Limited; Fellows Bros., Limited; R. C. Gibbins & Company; Rowland Priest; Stringer & Son (Cradley Heath), Limited; Tangyes, Limited; William Thomson & Company (Kinning Park), Limited; the Vaughan Crane Company, Limited; and Youngs (Birmingham), who claimed to represent the majority of the manufacturers of the product in the United Kingdom. The only opposition came from the Yale & Towne Manufacturing Company, represented by Mr. J. R. Wilder (general manager of their British division).

MR. J. B. CORRIE (chairman, Foundry Equipment, Limited) represented the applicants. The applicants stated that there were quite a large number of chain or pulley blocks imported annually, and while no production figures were available, the applicants maintained that they could produce sufficient to meet all demands in the United Kingdom. The difference between the British and the imported product was not apparent to most purchasers, although experts in the trade could distinguish between them. Unless the imported goods bore a clear indication of origin, consumers were unable to discriminate between the goods of foreign and home manufacturers, and so exercise their preference. In fact, many consumers were not aware that their blocks were of foreign origin until they had a call to replace parts, when they were greatly inconvenienced, having to wait weeks for delivery. It was not uncommon for chain or pulley blocks to be purchased from advertisements. The applicants desired, therefore, that advertisements covered by the Acts should also bear an indication of origin.

The applicants asked that each imported pulley block or chain block should bear the marks die-stamped or cast on the hand wheel and on the outer casing in a conspicuous manner. It was also urged that the goods should be required to bear the marks of origin at the time of importation. It was suggested that three months' notice would be ample to allow all unmarked stocks at present in the country to reach consumers.

MR. F. R. DAVENPORT (a member of the Committee) asked if there were much difference between the prices of the British and the foreign blocks, and MR. R. W. SAGE (Chas. Willetts, jun., Limited) replied that in many cases the foreign blocks were 60 or 70 per cent. cheaper.

MR. WILDER, cross-examining, said the blocks imported by his company were not of low price, and he mentioned £5 12s. 6d. as the price of a ½-cwt. pulley block supplied by his firm, whereas the price for a similar British article was £4 15s.

Addressing the Committee, Mr. Wilder urged that the manufacture of chain blocks in this country was very large indeed, while imports were negligible, and applied only to one type. Therefore, there was no justification for a Marking Order. Mr. Wilder added that the blocks supplied by his firm already had a mark of origin on one side.

MR. CORRIE, addressing the Committee, urged that imported blocks should be marked in such a manner that purchasers would know at a glance whether they were buying British or foreign blocks. The applicants did not wish to hit the American firms, such as that of Mr. Wilder, who were already marking.

The Committee will report to the Board of Trade.

MESSRS. ALBION MOTORS, LIMITED, Scotstoun, Glasgow, have just completed two specially-constructed omnibuses for carrying passengers from Baghdad across the Syrian Desert to Damascus and then on to Jerusalem. The Baghdad-Damascus system of the route, approximately 530 miles, has no proper road, and transport at some seasons is difficult. On this route the new omnibuses, each with an engine developing 110 h.p. and carrying 150 galls. of petrol, will be run.

The Institute of Metals

TWENTY-SIXTH ANNUAL GENERAL MEETING

At the twenty-sixth annual general meeting of the Institute of Metals, held in London on March 7 and 8, 1934, the retiring President, Sir Henry Fowler, K.B.E., LL.D., D.Sc., inducted the incoming President, Dr. H. Moore, C.B.E., into the chair. The Secretary presented the Report of Council for the past year.

On December 31, 1933, the names of 122 original members were included in the total of 2,038 ordinary members. On December 31, 1908—the end of the Institute's first year—the original members numbered 355. During the past year 133 members and students were elected, a figure that compares with 120 in 1932 and 205 in 1931.

The twenty-fifth annual autumn meeting was appropriately held in Birmingham, in which city the first autumn meeting had been held in 1908. The "Silver Jubilee" meeting was well attended. Fourteen Papers were presented at the meeting, and the autumn lecture was given by MR. W. R. BARCLAY, on "Twenty-Five Years' Progress in Metallurgical Plant." Following the reading and discussion of the Papers, members visited works and other places of interest in Birmingham and neighbourhood.

Election of Officers

The SECRETARY announced that the Council for the year 1934 had been elected as follows:—

President.—Dr. H. Moore, C.B.E., D.Sc., Ph.D.

Past-Presidents.—Sir John Dewrance, G.B.E.; Sir Henry Fowler, K.B.E., LL.D., D.Sc.; Dr. W. Rosenhain, B.A., D.Sc., F.R.S.; Dr. Richard Seligman, Ph.nat.D.; Mr. Leonard Sumner, O.B.E., M.Sc.; Prof. T. Turner, M.Sc., A.R.S.M.

Vice-Presidents.—Mr. W. R. Barclay, O.B.E., London; Dr. C. H. Desch, D.Sc., Ph.D., F.R.S., Teddington; Dr. A. G. C. Gwyer, B.Sc., Ph.D., Warrington; Prof. D. Hanson, D.Sc., Birmingham; Mr. H. C. Lancaster, London; Mr. E. L. Morcom, M.A., Birmingham.

Honorary Treasurer.—Mr. John Fry, London.

Members of Council.—Prof. J. H. Andrew, D.Sc., Sheffield; Mr. S. L. Archbutt, F.I.C. (representing the Local Sections); Engineer Vice-Admiral H. A. Brown, C.B., London; Dr. H. W. Brownsdon, M.Sc., Ph.D., Birmingham; Engineer Vice-Admiral Sir Robert Dixon, K.C.B. D.Eng., London; Mr. Maurice S. Gibb, C.B.E., J.P., West Hartlepool; Mr. K. Gray, Sheffield; Mr. H. H. A. Greer, J.P., Glasgow; Dr. J. L. Haughton, D.Sc., Teddington; Prof. R. S. Hutton, D.Sc., Cambridge; Mr. Wesley Lambert, C.B.E., A.K.C., London; Mr. A. H. Mundey, London; Mr. A. J. G. Smout, Birmingham; Mr. James Steven, Glasgow; Mr. F. Tomlinson, Manchester; Mr. H. B. Weeks, F.I.C., London.

The new PRESIDENT then delivered his address, of which the following is an abstract:

PRESIDENTIAL ADDRESS

In a recent book* T. A. Rickard has expounded, with a wealth of historical fact, the theme that "civilisation was developed on a metallic basis." On this question it is not easy to distinguish between cause and effect. Whether man's early steps towards civilisation led to, or alternatively were conditioned by, his gradually increasing use of metals may be a matter for argument. Certain it is that metals are the chief material basis of our present industrial civilisation. Some other materials stand higher than the metals as primary necessaries, in the quantities used, or in money value, but every kind of production, industry, transport, and communication is now dependent on metallic tools, machinery and other equipment. The extent to which this dependence has increased in our lifetime is illustrated by Rickard's statement that during the first twenty-five years of the present century the world consumed a larger quantity of the metals than in all preceding time. Figures given by Sir Harold Hartley, in the 1933 James Forrest Lecture, for the world's production of twenty-one metals in 1900 and in 1930 show that production had at least doubled for all the common metals in these thirty years, whilst in some cases the increase was far greater; for example, about thirty-six times as much aluminium was produced in 1930 as in 1900. In quantity produced, iron exceeds all other metals combined. The world is equipped to-day to produce not less than 130 million tons of steel per annum, as compared with probably not more than 8 million tons of other metals in all forms. In variety and importance, however, the ratio is very different. Further, one of the main metallurgical trends of the present time is the increasing dependence of iron on non-ferrous metals, both as alloying conditions and as protective coatings, for overcoming its corrodibility and improving its other properties.

An Important Industry

An indication of the importance of the non-ferrous metals industries in Great Britain is given by the Census of Production figures for 1930, which show that the value of non-ferrous metals and alloys, excluding the precious metals, produced as ingots, castings, plate, rod, tube and similar forms is not less than £40,000,000 in a normal year, copper and copper alloys accounting for about half this amount.

These few figures are sufficient to show that the field of this Institute in the study of the non-ferrous metals and their utilisation is large, important and increasing. In this sphere the Institute has played a great part in the encouragement of science. It exists "to promote the science and practice of non-ferrous metallurgy," but as practice becomes increasingly dependent on science, I do not think that I am biased in suggesting that we are, and must always be, primarily a scientific body. It is true that some of our most active and helpful members modestly disclaim any considerable scientific knowledge, but they often do themselves injustice in this matter, and I think that their membership is proof of their interest in and support of science. It is an obvious truth that the increasingly rapid progress of science and its application to every side of life is one of the outstanding characteristics of the present day. Indeed, our progress in this direction has been blamed for the unpleasant symptoms of industrial and economic dislocation which continue to shake our civilisation. That this view is fundamentally erroneous has been well shown very recently by Mr. H. T. Tizard.* Other causes, immensely potent, amply account for the economic troubles of the world, and I find it impossible to believe that our difficulties of the last few years would in any way have been lessened if science and its application had halted in their progress. There is indeed much to be said for the view that the effects of the industrial depression have been mitigated in some directions by scientific progress, and certainly some of the newer industries which have arisen purely as a result of the advance of science have suffered far less than the primary producing industries and the long-established so-called basic industries.

Metallurgy and Civilisation

The dangers of a civilisation which rests so largely on a basis of applied science while a truly scientific outlook is confined to a very small proportion of the population have often been pointed out. I hesitate to say whether they are any greater than the dangers to which all civilisations have been exposed—dangers so abundantly illustrated throughout history. They are, however, very real, and I think that there can be little doubt that the stability of our civilisation would be steadily strengthened by a growth of the scientific outlook throughout all sections of the population. This is primarily a matter of education, but education is by no means confined to schools and universities, vastly important though these agents are. I suggest that in promoting the spread of scientific ideas throughout the metallurgical and other industries we serve, we are doing far more than merely making these industries more profitable to those who are dependent on them; we are encouraging forces making for stability and ordered progress in civilised life.

I have spoken of stability and of civilisation resting on applied science. These expressions may be misleading. Whatever modern civilisation may do, it cannot rest, nor can its stability be of the static kind we seek in our structures. It can only be a balance, continually adjusted, of powerful forces and perpetual movements. We must abandon the ideas of permanence, of keeping things as they are, of a goal where we can rest when we have reached it. Continual change is our lot. Indeed, it has always been so, although to us it may seem that the rate of change is faster than ever before.

All this may be thought to be remote from the matters which primarily concern this Institute. What I want to suggest is that in the industries and institutions in which we are interested, we must accustom ourselves to the idea of constant change, of continual progress, of the rapid absorption and application of new knowledge and fresh ideas. The alternative is growing disharmony in our technical and economic organisation as we fail to change in a changing world. In industry it is not merely a matter of losing markets to our competitors; this is a symptom, though a very important one, of a failure to take our part in the march of progress. It must be admitted that in some sections of industry there is still great inertia. Reluctance to take part in the search for useful new knowledge, and even to make use of knowledge which is freely offered, is still too prevalent.

Growth of Research Organisations

Anyone considering the present position of science in industry must first be impressed by the extent to which the industrial scientific organisations, and the use of really scientific methods in manufacture, are the creation of the last twenty years. Some important and active research laboratories have been maintained much longer than this by the dyestuffs and other branches of chemical manufacture, and by the electrical industry, but it is broadly true that the large industrial research laboratories of to-day either did not exist, or were merely a fraction of their present size, twenty years ago. The staff of the National Physical Laboratory, which has a large output of industrial research as well as other work, was about 150 in 1913 and 590 in 1933.* A Bulletin of the National Research Council (U.S.A.) issued in 1933 gives particulars of 1,575 industrial research laboratories in the U.S.A., few of which were in existence twenty years ago. It has been estimated that about £1,000,000 is spent annually on metallurgical research and development in the United States.† The Mellon Institute of Industrial Re-

* T. A. Rickard, "Man and Metals." New York and London, 1932.

* "Science and Industrial Depression." Presidential Address to the Science Masters Association, January, 1934.

* See N.P.L. Annual Reports.

† C. E. MacQuigg, "Research and Development in Metallurgy." J. Franklin Inst., 1932, 213, 583-604.

search was founded in 1913, and the Battelle Memorial Institute is more recent in origin. These are two outstanding examples of many large institutions undertaking metallurgical research for industrial purposes. None of the British Research Associations is yet twenty years old.

It is perhaps more interesting to study, beyond the mere growth of industrial research, the ways in which co-operation has fostered this growth. Towards the end of the war the Government began its great experiment resulting in the establishment of more than twenty Research Associations, in which different sections of an industry, and many different industrial concerns, co-operate among themselves and with the Department of Scientific and Industrial Research to carry out research and development for the benefit of the industry. The lately-issued Annual Report of the Department gives in some sixteen pages a broad review of the experiment from its beginning, when " the scheme visualised the formation of national research organisations to stand behind and supply with new ideas, new methods, new standards of quality, the principal industries of a nation dependent for its very existence on its power to feed itself by means of the sale of its manufactured articles." Not less than £3,000,000 has been applied by the Associations in research and related activities within fifteen years, but, while recognising the substantial success of the experiment, the Department is emphatic in its view that research associations are in their infancy and that a substantial development of the movement is needed.

In our own industries there are three main groups, engaged respectively in the mining and production of metals, in the manufacture of semi-finished products and in the production of finished articles. Each group overlaps the others to some extent, but the classification holds broadly. Until comparatively recently the producers of the raw non-ferrous metals rarely took much interest in their products after they had sold them, and, incidentally, they regarded the field of the Institute of Metals as being outside their province. A profound change in their attitude, gradual at first, is now proceeding rapidly. The nickel producers have found it worth while to study in great detail the ultimate uses of nickel, and to spend large sums in research and in the development work necessary to secure the application of the results of research. In similar or other ways the producers of aluminium, copper and tin are following the same policy. It is especially interesting to note that this is leading to co-operation, not merely between the producers of a particular metal—as, for example, in the International Tin Research and Development Council—but between the primary producer and the manufacturer of semi-finished products, and, further, between the groups in these two classes in several different metals. Thus, the British Non-Ferrous Metals Research Association includes in its membership producers of copper, aluminium, nickel, tin, zinc, lead and other metals, as well as the manufacturers of plate, bar, tube, wire, etc., and many classes of users. In this way all these interests jointly support and control research for the non-ferrous metals industries generally.

Labour Strength of British Factories

There is, however, one most important section of industry which as yet is scarcely touched by the movement towards co-operation in the advancement and application of science. Sir Frank Smith, whose position as Secretary of the Department of Scientific and Industrial Research enables him to keep his finger on the pulse of science in industry more constantly than probably anyone else, has pointed out, in his 1932 Norman Lockyer Lecture, that in 128,000 factories employing about 5 million workers, less than 500 employ more than 1,000 workers each and more than 100,000 factories employ fewer than 100 workers each. These figures show that the great majority of these 5 million workers are employed in small industrial units. In the non-ferrous metals industries there are thousands of concerns which, although as a rule individually small, in the aggregate constitute a most important section of manufacturers, as measured by the total capital used, the number of workpeople employed and the value of their total production. They are engaged in the manufacture, from the intermediate products which they buy, of finished articles of enormous variety, by processes of drawing, spinning, welding brazing, soldering and so on. They apply surface finishing processes such as polishing and electro-plating. By long experience, trial and error, and empirical skill often raised to great perfection, they may be thoroughly expert in their particular line of work, but it is rarely that they regard themselves as in need of any scientific knowledge. Here is an undeveloped field for the extension of science in industry, and there is no doubt that these concerns might profit greatly from association with technical organisations. More scientific training and knowledge among the controlling personnel of these small units appear to be needed if they are to take advantage of what science can do for them. Thus we are brought back to the question of the scientific outlook.

Narrowing the Gap

It will at once be admitted that on the purely scientific side the distinction between ferrous and non-ferrous metallurgy is wholly artificial. The problems of crystallisation from the liquid state, effects of hot- and cold-working, constitution of alloys, and control of structure and properties of heat-treatment are essentially similar; so also are the various complex phenomena exhibited by metals and alloys when subjected to stress—elasticity, plastic distortion, creep, fatigue, and so on. Several alloy systems show their own characteristic phenomena not found in other alloys; this is true of the iron-carbon system and the extraordinarily complex and varied series of alloys based on that simple binary system. The progress now being made by Dr. Hume-Rothery, at Oxford, in his search for wide generalisations, based on crystalline and atomic structure, seems likely to bring more order into the apparently unrelated differences between different alloy systems, and possibly in time the peculiarities of some alloys may appear to be less peculiar from the scientific point of view.

Even on the practical side, where the distinction is real and important, there is much common ground in ferrous and non-ferrous metallurgy, and it may be worth while to consider briefly some of the sections of metallurgy in which the common interest of the ferrous and non-ferrous sides has some special features. The subject of corrosion will at once occur to us all, because of its practical and economic importance, together with the difficulty and scientific interest of the problems it puts to us. If the subject is held to include corrosion fatigue and oxidation at high temperatures, the durability of metallic structures and components depends almost solely on corrosion and abrasive wear. Research on corrosion is now probably more active than ever before. In our own country several large industrial laboratories are taking an important share, perhaps mainly on somewhat empirical lines, a good deal of attention properly being paid to methods of testing corrosion resistance which will give a trustworthy guide to behaviour in service. The more fundamental work proceeding in the laboratories of Dr. U. R. Evans at Cambridge and of Dr. G. D. Bengough at Teddington is well known to all of us. This Institute was responsible for much pioneer work in its condenser tube corrosion research, transferred a few years ago to the British Non-Ferrous Metals Research Association, and still in active and fruitful progress. In its atmospheric corrosion research, extending over a number of years, that Association did much to establish and extend the explanation of corrosion resistance by the formation of oxidised protective films. The building up of these films, before or during exposure to corrosive conditions, their continuity, adhesion and impermeability, their damage by mechanical or other action, their effective repair when damaged, are now recognised as the essential features of corrosion resistance in metals and alloys when not protected by coatings of other materials. It is obvious that corrosion research cannot be sharply divided into ferrous and non-ferrous, the mechanism of oxidation, general or local, and of film formation or breakdown, being much the same in steel as in many non-ferrous alloys. The phenomena of intercrystalline attack under corrosive conditions, exhibited in so marked a degree by the earlier austenitic chromium-nickel steels of the 18:8 type after certain kinds of heat-treatment, is found in a number of non-ferrous alloys, and the explanation found in the one case may have application in others, as may also the remedy.

Corrosion Problems

Corrosion leads to protection, and the position here strikingly illustrates the non-ferrous invasion of ferrous metallurgy. The stainless steels contain large percentages of non-ferrous metals, but still more important is the use of non-ferrous metal coatings to protect steel from corrosion. Tin, zinc, nickel, chromium, cadmium, aluminium, applied by hot-dipping, electrodeposition, or other method appropriate to the metal used for protection, are all effective for particular conditions of use. The suppression of porosity in tin coatings, of cracking in chromium plating—to mention two directions in which there is need for progress—would benefit a number of important industries. This is clearly a field in which there is no rivalry between ferrous and non-ferrous metallurgy, but a call for co-operation in a common aim.

In a widely different section, the casting of metals and the production of ingots and castings free from defects which reduce their serviceability, the connection is less obvious. The methods of steel melting and the scale on which it is commonly carried out, as well as the special characteristics of liquid steel, might be thought to render the production of sound steel ingots an entirely individual problem. The five substantial reports of the Heterogeneity of Steel Ingots Committee of our sister Institute make little reference to non-ferrous ingots. Nevertheless, these reports may profitably be considered together with a book just published on the " Casting of Brass Ingots."* The phenomena of crystallisation, shrinkage and piping, segregation, gas cavities, effects of turbulence of the stream of metal in the mould, and oxidation of the surface of the liquid metal are common to most alloys, including steel, although their relative importance varies widely in different materials. The intricate problems connected with gases in metals are particularly difficult to attack in the case of steel, because of the high temperatures concerned and the complexity of the chemical and physical equilibria applying, of which so little is known. It is not unlikely that the somewhat more amenable, although still difficult and important problems of gases in copper and aluminium and their alloys may yield more readily to investigation. Extensive researches on these materials are, in fact, leading to generalisations which may have application to many other alloys.

Engineering and chemical progress continue to make more insistent demands for materials to withstand high temperatures. This has led to intensive investigation of the creep of materials under stress at high temperatures. Much of this work is necessarily empirical, amounting to the determination of the creep characteristics of steels of different types and the study of the effects of different alloy elements on creep.

* Genders and Balley: "The Casting of Brass Ingots." British Non-Ferrous Metals Research Association, 1934.

The Patternmaker's Foundry Sense

This Paper, which was published in our issue of February 1, 1934, gave rise to an interesting discussion. Mr. Arthur Phillips presided.

In proposing a vote of thanks to the lecturer, MR. T. MAKEMSON remarked that the lecturer and he had worked together in former times. To give a Paper upon a practical subject like patternmaking was not easy, and Mr. Edwards was greatly to be congratulated upon the way he had tackled his subject, and dealt with some very important points which all practical patternmakers ought to know, and which they all thought they knew, but which they frequently ignored in practice. The points which had been brought forward in the Paper could not be too strongly emphasised.

MR. S. G. SMITH seconded the vote of thanks.

MR. EDWARDS, in responding to the vote of thanks, said that he used the term "pachydermatous" in the sense that a foundryman had to inure himself to the rough and tumble of one of the roughest of lives followed by any man in industry. He had to have one of the finest brains and also one of the toughest bodies in order to deal successfully with his job.

Box-like Castings

MR. PHILLIPS said he agreed with the remarks regarding deep core prints and setting pieces on cores; also with regard to indications on patterns as to whether the core cut through or what it had to do. If one had a box-shaped casting, and had to make a cover, would it be desirable to use the sand contraction for the box-shaped casting, say, 4 ft. square, using a dry-sand core, as one would, say, for the lid, making it in green sand so that the lid might fit the box perfectly, and also in the description of the corebox using a strickle, did the lecturer consider he would obtain as true a core using a strickle as using a full corebox?

MR. EDWARDS pointed out that Mr. Phillips apparently wanted a perfect fitting lid, and he should say that he could not get it. With a box-shaped casting 4 ft. square, making the box in a dry-sand core and the lid in green sand, how would it be possible to control the moulder's rapping propensities on the lid to start with? Again, with regard to the box, was it to be made in oil sand or red sand?

MR. PHILLIPS said he would assume it was to be made with oil sand.

MR. EDWARDS stated that the oil sand played some peculiar tricks sometimes. It would drop down like a pancake, and the sides would come out considerably larger than they were expected to do. It was very seldom that the trouble was taken in a foundry to try the core (dried) in the corebox, and with an oil-sand core it was necessary. He would not profess to be able to produce a lid to exactly the same size as a cored job within a thousand or two.

The CHAIRMAN said he meant within $\frac{1}{16}$ in.

MR. EDWARDS said that was $\frac{1}{32}$ in. a side. He would not attempt to do it without allowing chipping or a little machining, unless he made a trial casting.

The CHAIRMAN inquired if Mr. Edwards would allow for a different contraction from that of the box.

MR. EDWARDS replied that the oil sand would prevent contraction with a thickness of metal, say, of $\frac{1}{2}$ in. He had had a recent experience with a similar job, namely, a 6-in. by 4-in. box. He would simply have the box cast, measure the space carefully, and allow for the ordinary contraction of the plate or a shade more.

MR. J. MASTERS (Shrewsbury) said that if the statement was made that one could not get an oil sand to stand up, then it was time the speaker used some good oil compound. In the case of several firms with which he was acquainted, their oil-sand cores had to go back in the corebox or else they rejected the core. In the case of a 4-ft. sq. corebox, they would want to know what was the thickness and what height the core was going to be. It was not to be expected that a core 2 ft. high and 4 ft. square, and which had a pie-crust formation, would stand up of itself. It was possible to make a pie-crust core of that shape and size from a proper mixture, so that it would go in the box without difficulty, by making a rebated box, so that the box came away without any rapping at all. It could be put in the stove and dried under temperature control. The greatest waste occurred through the cores not being dry. One of the greatest bugbears in a foundry was not having proper temperature control in the core stoves and demanding castings within a reasonable time; possibly giving a day for a man to make a core and deliver a casting. A principal cause of core distortion was inefficient core-stove management. Not knowing Mr. Edwards' mixtures of oil sand, he could not dispute the point, but if he would like to know of some that would stand up without distortion, it was available.

Squatting of Oil-Sand Cores

MR. EDWARDS said that producing an oil-sand core which would stand up was an art of the foundryman. Mr. Masters evidently knew his job. He had spoken of making a box so that it came away without wrapping. Even if a corebox was made so that after the core was rammed up the sides were taken away, and the core was carried to the stove, the core would squat to some extent.

MR. MASTERS: Why carry it?

MR. EDWARDS said that if it was two feet high, it would be shaken by transporting it on a carriage to the stove. Did Mr. Masters make his in the stove?

MR. MASTERS said he took it on the plate in the box. The carriage ran on ball bearings.

MR. EDWARDS said that even the best oil sand was in the nature of a putty formation. Unless the sides of the box were left an hour or two it was not perfectly hard when the box was taken away. Core sand was of a plastic nature, and it was well known that such materials underwent a sort of flattening in course of time. If an oil-sand core 2 ft. 6 in. deep did not flatten out, something was wrong with science.

MR. MASTERS said he could not agree.

MR. EDWARDS said he thought a core 2 ft. 6 in. high could not retain its perfect size while it was being put into the stove. If Mr. Masters could make it do it, then he should say that he had achieved the impossible.

MR. MASTERS said that he would be pleased to give a demonstration that it could be done at any time.

MR. H. STEAD thanked the lecturer for the breezy way in which he had put forward the case for the patternmaker, and said the only criticism he had to make with regard to the Paper was in respect to cores being cut through. This was a fault which could be ascribed to the patternmaker, because there was always one of two obvious things to do. If the core did not run through, then make the core to the right length and it would not cut through. If it was left to the moulder it was exceedingly likely he would do the wrong thing.

MR. S. G. SMITH thought that Mr. Edwards had shown his foundry sense in regard to the 4-ft. box by saying he would not attempt to make both at the same time, and that he would make the box first and the cover afterwards. Even if the contractions were correct, another form of contraction in a cover 4-ft. square plate $\frac{1}{2}$ in. thick was the camber, which would very likely occur in a casting of that thickness. Foundry sense was exemplified in production which entailed the least cost for the greatest number of workers engaged, the avoidance of personal antagonisms, the pooling of ideas, and the adoption of the slogan "co-operation." The patternmaker's sense and the moulder's sense were, in some respects, similar, but, in other respects, different. The patternmaker was always on the lookout for a pattern with some improvement on it; the moulder's foundry sense was to ram up the mould, vent it, put a good skin on it, and do all the other things which went to make a good casting. The foundry sense of both could only be acquired after many years of practical experience. Take, for example, a large intricate casting made in loam or sand, whether in iron, steel, or non-ferrous metal, the production of which involves questions of cost, mode of procedure, contraction, and possibly machinery allowance, camber and cupment of gases, etc., should receive the combined attention of the designer, the patternshop, and the foundry. The designer might be able to eliminate or alter some part which would simplify the making of the pattern, and the moulding of the casting, much time and expense being saved. It might be thought that such a suggestion was obvious, but how often, to the dissatisfaction of all concerned, was it not done? It was once part of his duty to fulfil the *rôle* of an intermediary between the drawing office, the patternshop and the foundry. So much foundry knowledge and general experience were required adequately to fill such a job that he came to the conclusion it was not possible for any one person to discharge such a function. When he stated that the foundry in question employed about 500 men, and that castings were made varying from 1 oz. weight up to 30 or 40 tons, his hearers would understand that anyone who was placed in that position would require to have a good deal of foundry sense.

A Lost Core Box

MR. EDWARDS stated that the steel casting, in which the core only went in a certain distance, was sent to a steelworks and was not dealt with in the foundry with which he was connected. If a casting was made in one's own foundry, it could be followed through better than if it was sent away to another firm 100 miles away. The particular job had a round print 3 in. in diameter on one side, and it was not painted to go through the other side. The root cause of the trouble was that the corebox had been lost in transit from the patternshop to the steelworks. The argument he put up about it was, since there was a print on one side of the job and no print on the other, or any indication that a core was required through, though there were several other coreboxes for the job, the moulder ought to have inquired about the one particular thing that was in doubt. Of course, when the moulder said it was not foolproof, that was another "slant" on patternmaking. Personally, he did not know that patternmakers were foolproof, though they tried to be. As a matter of fact, a fifty-fifty arrangement was arrived at; so evidently the moulder thought he was partly to blame. In subsequent practice there was painted on the pattern how many coreboxes should go with the job.

Mr. Masters had referred to the fact that he had a carriage with roller or ball bearings which should be the case with a properly-constructed truck or runner; but, as a patternmaker, he would not like to act upon the assumption that the cores were to be transported with such a carriage as that.

MR. C. A. OTTO thought it required a good deal of courage on the part of Mr. Edwards to come to a meeting of foundrymen and tell them that only 5 per cent. of the people had directional ability. Were these necessarily patternmakers, or was it that only 5 per cent. of the patternmakers had directional ability coupled with the necessary foundry sense? His

own experience was that foundry sense was a very variable quality, and that with some patternmakers it was a negligible quantity. When he was a boy he examined a very beautiful pattern that came into a foundry. So beautiful did he consider it that it was placed on a pedestal for visitors to see. It remained in that position for about a day until the foreman moulder examined it, and his language concerning it was unprintable. The beauty of it was all on the surface. It happened to be a compound cylinder made substantially in one, and the screwholes were puttied up and varnished, while all the flanges were glued and firmly secured. This pattern had been made by a patternmaker without a true foundry sense, and not by a carpenter.

MR. E. LONGDEN (Manchester) said that the statement was often made that the practical foundrymen were inarticulate, and perhaps they had shown themselves to be so that afternoon because MR. EDWARDS had somewhat taken the wind out of their sails. Emphasis should be laid upon the point mentioned by the lecturer with regard to the attempt on the part of designers to cut metal in castings. It was an absurd practice. It was too often assumed that if a certain class of casting was generally produced at, say, 16s. a cwt., that a reduction in weight would be represented by a corresponding reduction of 16s. per cwt., whereas the maximum economy was the saving in metal only. On the other hand, the thinning down very often increases the moulding difficulties, increases the cost of the remaining metal, which for a thin section may be dearer, and an increased danger of rejections.

The patternmaker not only had to have a strong foundry sense but also a very strong engineering sense. The foreman patternmaker had a wider knowledge, generally speaking, of the requirements of an engineering works than any other type of supervisor. The position spoken of by Mr. Smith would be admirably filled by a patternmaker with an unusually good knowledge of foundry work because he came midway and had a good understanding of drawings on the one hand and also an understanding of foundry requirements and the engineering side.

MR. EDWARDS said that a foundry science had not yet been firmly established by any means. The fact that it took a man a lifetime to acquire a good knowledge of foundry work proved that the subject was a very difficult one to understand. It was in 1890 that his father made a patternmaker of him, and it was only within the last few years that he had really understood many matters of foundry requirements; yet he had been earning his money as a patternmaker, and most of the time as foreman and manager. The patternmaker was not guided by mathematics, he did not use a slide rule, no metallurgical knowledge assisted him, and he did not employ a test-tube. None of the problems with which he was confronted could be worked out in the laboratory. Everything had to be done by a sort of cumulative *thought* power, by slogging constantly at foundry knowledge, and making it a daily and nightly study. It was highly important, also, to associate with good foundrymen and learn by listening to what they had to say.

Another American Firm for Birmingham

It is announced by the City of Birmingham Information Bureau that the Cincinnati Milling Machine Company are shortly to manufacture their products in Birmingham. Work has already commenced on the erection of their factory on a three-acre site on the new Pype Hayes industrial centre; the first section of the factory has a ground-floor area of 30,000 sq. ft., and is expected to be completed by June. The sales side of the business will continue to be handled by Messrs. Charles Churchill & Company, Limited, of Birmingham. The Cincinnati Milling Machine Company are the sixth American firm to establish works in Birmingham, and the third during the past twelve months.

The Use and Abuse of Chaplets

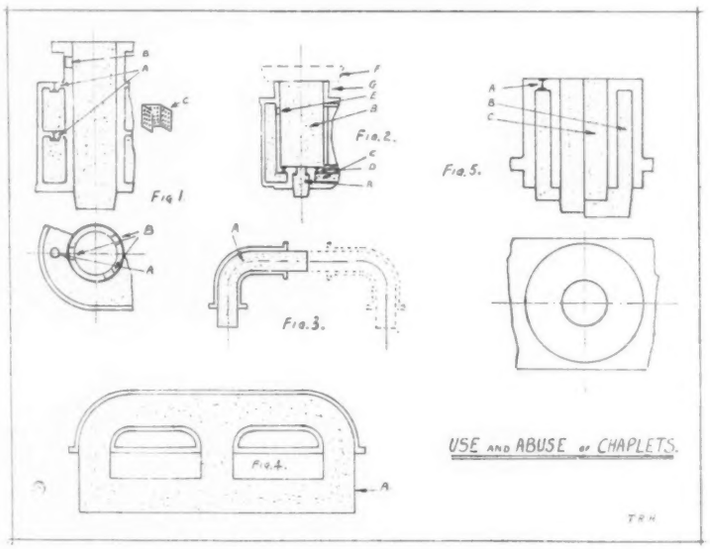
BY T. R. HARRIS

To hold a core in position during casting and until the metal has completely solidified, is the function of chaplets. Although they all fulfil this purpose, they are of diverse forms, and what is suitable for one job may not be of any use for another.

Chaplets should be used with great discretion, and not more than is absolutely necessary to keep a core down and counteract the upward thrust of the metal, due to the operation of the principle of Archimedes. To use them more than this is to abuse them, for chaplets, after they have fulfilled their duty of keeping the core in position, become a source of weakness rather than of strength. Castings that are subjected to pressure will be found invariably to leak around the chaplet rather than elsewhere, so that if it is necessary to use chaplets, they should be placed in such a position that they could be easily plugged if required. When the metal between cores, or between the mould and a core, is thin, and it is necessary to use chaplets to support the core, a boss should be made in the job so as to receive a thicker chaplet. If a thin one were used, possibly it would not unite properly with the metal, because of the metal becoming chilled and not fusing it, whereas, if a boss receives the chaplet, it is more likely of becoming one with the surrounding metal. Fig. 1, A, shows a boss in a water-jacket core and illustrates the point. B in the same figure shows a perforated stud keeping the cylinder-bore core in position.

Studs and chaplets should be avoided as much as possible in cylinder bores, but where their presence is essential to maintain the core in its correct position, one, as shown at B, should be used. This is shown in more detail at C, and is a perforated stud with the side which abuts against the cylinder bore cut away, leaving just two thin metal edges, which minimise the risk of leaking around this place. Fig. 2 shows a method used to eliminate chaplets in a cylinder body. As originally made, core A was placed in a print and core B on studs which rest on core C as at D. Studs were also used to keep core A in position as at E, giving unsatisfactory results. To eliminate studs entirely from this cylinder bore, a print at F was placed on top of head G; a joint was taken on top of this to extract print and head, and, on assembling, this kept the bore core up in its correct position without the use of any studs whatever.

For work of this nature which is required to be specially sound, the elimination of chaplets can be effected by properly printing the pattern and making the cores so that they register and balance themselves. Fig. 3 shows a common type of bent pipe which, if made as shown, would need a chaplet at A to balance the core. If another one was added, as shown in dotted lines, and the core made in one piece, these both could be cast without any chaplets at all. Fig. 4 illustrates the same principle applied to a water manifold; print A balances the core in the mould without the aid of chaplets. Fig. 5 shows a different type of job. It is a portion of a casting the remainder of which decides that it is cast in the position shown. The left-hand view shows the original coring arrangements, the right-hand view that ultimately adopted. It will be seen that the first method needed a chaplet at A to keep the core down. Although not detrimental to the job, seeing it had not to withstand pressure, etc., the use of chaplets here was considered an unnecessary expense both in cost of chaplet and time in securing them. The method shown in the right-hand half of the figure shows core B being kept down by core C, this in turn being kept down by the top box. A simple alteration such as this can be made to save a considerable amount of money during a year. There are many other instances which may be cited in which the number of chaplets required have been reduced and in some cases entirely eliminated by the careful planning of the pattern work with due regard to, and provision of, adequate core prints, but enough has been said to draw attention to the importance of the correct use of this valuable foundry expedient.



Japanese Iron and Steel Merger

It is reported from Tokio that after prolonged negotiations, the Japanese Government has sanctioned a merger of the Government and private iron and steel works. The new combine, which will be known as the Nippon Seitutsu Kaisha (Nippon Iron Manufacturing Company), will have a capital of 345,940,000 yen (approximately £21,621,250 at current rates). The managing director will be Viscount Inouye, former Minister of the Railways and President of the South Manchuria Railway. The Government will receive 5,683,000 shares, valued at 50 yen each, as compensation for turning over the assets of the Yawata Ironworks and its subsidiary companies. These assets are valued at 284,195,000 yen (£17,762,190). Three privately-owned companies and two steel companies are being absorbed at a valuation of 61,640,000 yen (£3,852,000). Two additional ironworks, valued at 18,718,000 yen (£1,169,875), are expected to joint the merger in April. The productive capacity of the combine is now estimated at 2,890,000 metric tons of pig-iron and 1,500,000 tons of steel annually. The merger has been arranged in order to rationalise the steel industry on the lines already successfully pursued in other Japanese industries.

Modern Iron Foundry Practice*

By R. C. H. Weeks.

The foundry and founding, generally, have during the last decade attracted an immense amount of attention, and it is somewhat difficult to speak upon any branch of the industry that has not been fully dealt with from various points of view by members of the Institute. At all events, it will be appreciated how impossible it is to deal adequately with the numerous aspects that occur to one as being of interest, and it is only possible to deal briefly with each section, in the hope that discussion may be stimulated. This is so often the most valuable portion arising out of the presentation of a Paper, and leads to an exchange of ideas and experiences.

The architectural design of a workshop has much more to do with its efficiency than is generally supposed. Particularly does this apply where the hot atmosphere and dust surround the moulder at his work. It is on that account therefore that spacious, well-lighted, well-ventilated and lofty buildings should be erected for foundry purposes. The health of the workman should be one of the first considerations when preparing plans for new buildings, as air space, good light, and as much fresh air as possible are necessities in the life of the moulder and every other worker in the foundry.

The building obviously should be constructed so that man-handling of any of the productive materials should be reduced to a minimum, and the metal, from the time it is molten at the spout, should travel "ahead" all the while until it reaches the machine shop or stores as a finished foundry product. This has been very ably dealt with by Mr. Faulkner in The Foundry Trade Journal.

Some foundries have gone to the extent of supplying bathing accommodation for the workers, and everybody realises how beneficial this must be, both from health and efficiency points of view.

The Melting Plant

With reference to the plant, it seems best to commence with the cupola, as the place where troubles start, and where it is essential that scientific control in all its aspects should be brought into play. Many years ago the cupola was simply looked upon as somewhere to convert pig-iron and scrap into molten metal, and little endeavour was made to ensure that the plant was run economically, and that the metal at the spout was suited to the various requirements for which it had to be utilised. The metal-to-coke ratio was sadly neglected, and so long as the metal was fit to run out of the tap-hole and fluid enough to supply the mould, no special attention was paid to the economical factor and means sought whereby satisfactory results could be obtained at a lower cost.

The modern ironfounder is not satisfied with these chance methods; as a matter of fact, the industrial situation and intense competition do not allow it, with the result that nearly all the devices known to modern practice have terminated in cheaper but very efficient metal, metal to analysis, metal to withstand the tests which modern engineering demands, both as regards tensile strength and good wearing properties. Cast iron is being produced to-day the strength of which before the war years would have been considered impossible for this class of material, with its practically negligible elongation properties.

The purchase of pig-iron to analysis is another definite advancement which shows the way science has helped to progress the industry, and it can safely be said that when the buyer specifies in an order an iron of, say, 3.0 per cent. Si and 1.0 per cent. P, he can be sure of obtaining this within very narrow limits. The uses of manganese are also rightly considered, and there again this content is rigidly controlled. Of course, if the products of the manufacturer can be tested in one's own laboratory, so much the better, but if this is not possible the user can usually rely on what he receives, especially in the case of those pig-iron manufacturers who realise so fully that their iron, if not to specification, can be returned to them forthwith. The speaker only had to resort to this unfortunate method once in his experience, and on that occasion the suppliers agreed that an error had occurred in despatch.

Before leaving the subject of the cupola, reference should be made to the latest development in this connection, and that is the balanced-blast cupola patented by the B.C.I.R.A. and Fletcher, which has recently been installed in several modern foundries in the country. There are now over 50 in operation or under construction. The new principle adopted in this cupola is that of controlling the air supply at the main tuyeres, by means of individual screw valves on each tuyere. Two other rows, and sometimes three rows, can be utilised above these main tuyeres, drawing their air supplies from the wind belt below.

The closing of the main tuyeres by means of the valves automatically provides for a larger amount of air passing through the upper tuyeres, and so the blast can be balanced to meet the varying requirements of the furnace.

Balanced-Blast Principles

It is some 25 years ago since a distinguished authority dealt with the composition of gases in front of the tuyeres in the cupola, and proved conclusively that free oxygen was present in considerable quantities, and that it remained unchanged in this area and must spread considerably before combustion to carbon di-oxide takes place; the two gases together forming a highly-oxidising atmosphere. Starting at the beginning of the reaction, in the melting zone, the molten iron drips through the coke into the hearth. That part of the liquid iron, which must pass the oxidising atmosphere, will suffer a refining action. Towards liquid iron only carbon monoxide, hydrogen and nitrogen are absolutely indifferent, whereas the least trace of CO_2 causes an oxidation of the dripping iron, because at temperatures over 1,000 deg. C. the reaction $Fe + CO_2 \rightarrow FeO + CO$ proceeds only in the direction of left to right. The dripping iron unites with the liquid iron in the hearth, and the oxide of iron attached to it form a cover over the iron bath, and exercises an oxidising action on the liquid raw iron. As a result of these findings, the balanced-blast cupola was evolved, where tuyeres are utilised capable of delivering air to the coke bed at velocities just sufficient to penetrate to the axis, according to the bore of the cupola at the horizon of the tuyeres. In this way, only sufficient oxygen is admitted actually to burn the coke to carbon monoxide, and, in consequence, the oxidising area is practically eliminated.

The study of the gas conditions and heat transferences in the various positions throughout the preheating zone, led the way to the examination of gaseous exchanges within the zone bounded by the tuyere horizon and the top of the coke bed, an area which can be described as the gas producer of the cupola. As a result of long endeavour, the conclusion was reached that if the gas reactions were to arrive at equilibrium in the region of the upper surface of the coke bed, there must be a means for adjusting the air supply through the lower tuyeres. It was clear that the heat necessary for the actual melting of the descending metal charge (being roughly about one-third that necessary for preheating) could be obtained by admitting a smaller quantity of air to the bottom tuyeres, and this necessitated further rows of tuyeres placed in a wind belt at convenient heights above the main bottom tuyeres. Through these upper tuyeres air could be admitted in sufficient quantity to burn the higher proportion of CO formed above the main bottom tuyeres to CO_2, when the tuyeres were correctly restricted in sectional area.

The effect of reducing the air supply to the bottom tuyeres is to reduce the amount of free oxygen in the outer area of the cupola section, and produce a higher CO content in the gases in the lower portion of the coke bed. The gradual addition of further air through the successive rows of upper tuyeres leads to a progressive increase of CO_2 and a gradual increase in the temperature as the top of the series of charges is approached.

The quotation of some actual results shows what a large saving in coke can be effected, together with hotter melting and increased efficiency all round. Two cupolas were put into operation in this particular test, and the diameter was 54 in. in each case, one being fitted with the balanced blast, and the other with the ordinary type wind belt and tuyere arrangements. Trials on different cokes showed that a single Durham coke gave lower consumption than a mixture of Durham cokes or a mixture of Durham and Scottish cokes. A series of three runs in the early tests on Durham coke gave a coke ratio (including the bed) of just over 12 to 1, melting 13.2 tons per hr. Tests on the sister cupola of the ordinary type with the same fuel showed an average melting rate of 12.5 tons per hr., the ratio being just under 10 to 1—quite a considerable difference. Later trials proved that the ratio of metal to coke was as much as nearly 15 to 1, and the melting rate increased to 13.3 tons per hr.

Taking the cupola as melting 100 tons per day, this would mean that each ton of coke would melt 3 tons more of metal, in other words, there would be a saving of 3 tons of coke per day. This extreme case is cited, as most founders are not associated with such huge outputs, but the saving on smaller cupolas is claimed to be in proportion, and is no doubt a definite advance on modern cupola methods.

Apart from the economies just mentioned, which are definitely capable of being expressed in cash value, other advantages are evident. The metal temperature remains about 1,450 deg. C. throughout the melt, the metal being not only very hot, but uniform from beginning to end, freer from non-metallic inclusions and gives higher quality castings with fewer rejections. Certain difficulties which are associated with the running of cupolas over long periods when the tuyeres run dull are overcome, and bridging is avoided. It is also found possible to patch the cupola with less ganister, and the brickwork is considerably cleaner.

With reference to the utilisation of existing cupolas to the balanced-blast methods just described, it is quite possible to have them modified for this purpose, the changes necessary being the provision of a new wind belt and lower part of the cupola, with valved tuyeres. It will be understood that the figures for coke consumption depend upon many factors, including the type of coke and scrap employed, but it can be taken for granted that the saving of coke can be estimated, at least, at 20 per cent.

Brackelsberg and Sesci Rotary Furnaces

These furnaces, lately installed on the Continent for the production of malleable cast-iron and grey-iron castings, are of a horizontal Rotary type, and designed primarily on pulverised coal as fuel, as opposed to coke in the ordinary cupola. It is not claimed that these furnaces can be run more cheaply than the cupola, but, by virtue of the lower cost of pulverised coal

* A Paper read before the Burnley Section of the Institute of British Foundrymen.

(usually German brown coal) compared with cupola coke, the makers suggest that it would not be dearer. The coal consumption for grey iron is estimated to be 10 to 1, and 7 to 1 for malleable, with oxidation loss of only 1 per cent. Molten-iron temperatures 1,400 to 1,500 deg. C.; also there is complete control over chemical composition and absence of contamination of melt by gases.

The labour of one man only is required, but in addition to the actual furnace auxiliaries are necessary. These comprise a pulverising mill, fed by a bucket elevator and charging hopper, and a bunker for the storage of dust. From here it is led, by means of a worm, to the burner itself, which can be withdrawn from the furnace. In addition, the main blast supply is provided by an electrically-driven fan. The use of steel scrap in the cupola is now an accomplished fact, and although it can be done successfully, its application must be carefully watched and not charged in any haphazard fashion. For castings of 2-in. thick section and heavy weight (including cylinder liners), the author has used as much as 20 per cent., taking care that the silicon content did not fall below 1 to 1.2 per cent. The metal was run into dry moulds, still warm from the drying stoves, and the castings gave wonderful wear and resistance to abrasion. In the case of green-sand moulds, and especially textile work, with some of the castings weighing only ounces, extra care must be taken. If it has to be used in small quantities, the silicon must not fall below 2.5 per cent., and the weight charged not more than 10 per cent.

If the molten metal is tapped in to ladles of 10-cwts. or 1-ton capacity, it has a better chance of becoming thoroughly mixed, but when small shanks are used directly under the spout, the risk is somewhat greater. In one textile firm where they have a large machine shop, the scrap ends of steel-bar material and tubes are sent to the foundry and are utilised by charging it very carefully at the beginning of the melt, and using this iron for all the heavy work (loom sides, etc.) first, and leaving it off for the small work which is cast later when the metal is at its hottest.

Cupola Linings and Patchings

During the last few years several firms have adopted the idea of utilising rammed linings for the refractory lining of the cupola to take the place of firebrick. Although there have been many successes, there have also been failures, a state of affairs which must naturally come about with a new idea. In spite of this, however, it can safely be said that rammed linings may have come to stay. At the present time the choice of a lining for the cupola rests between the firebrick and a rammed lining formed of a sand and clay mixture. Work carried out recently at Sheffield University has shown that there are great possibilities of materials which have not yet been properly tried out under working conditions, as it is not always easy to borrow cupolas for experimental purposes. One always likes to hear of improvements which definitely are improvements, but the average foundry chief is reluctant to change unless it has been definitely proved that the new idea is superior in length of life, and, in consequence, economically sound.

The failure of rammed linings in certain instances is due to reasons not far to seek, and to anyone who has studied the production of firebricks it is very obvious. First of all, the firebricks are made of weathered fireclay, and after a time are crushed and ground with water and burnt clay, and then moulded into definite shapes. The moist bricks are allowed to dry slowly on a heated floor, and afterwards placed in a kiln, where the temperature is gradually raised to 200 deg. C. or so. The kiln is kept at this heat for some considerable time, and then raised gradually to 500 deg. C. and afterwards rapidly to 1,300 deg. C., at which the bricks soak for several days. Cooling then takes place slowly, and by the time the bricks are withdrawn perhaps a fortnight has elapsed.

The rammed linings should be treated in almost the same way to produce beneficial results, and it is the quick utilisation of the cupola before the lining is properly prepared which has caused the cracks and shrinkage troubles and rendered the refractory more or less useless.

Many of these remarks apply to ganister daubings. These are often put on too wet; the cupola is used the same day, and consequently fall off from the brickwork they are meant to protect. The production of a good junction between a moist substance like ganister and firebrick is not an easy matter, and one which might be tackled by experts on cupola practice. The author's staff usually splashes the brickwork with ordinary clay water, and this helps the ganister to adhere more readily.

Mechanical Charging

To eliminate human effort at the actual charging door of the cupola appears to be the aim of many modern founders, but, personally, the author has not seen a mechanical charging machine in operation up to now. The method consists, in many cases, of utilising buckets similar to those used in charging blast furnaces. They are made of steel-plate with riveted seams. The bottom consists of a cone, from the apex of which a bar ending in a loop forms the suspension point.

Separate from this is a plain cylinder provided with a flange round the top rim, and normally resting on lugs on the periphery of the cone. It is this possibility of movement of the bottom relatively to the sides which permits the charge to slide through the annular opening, which increases as the bottom is lowered, while the cylinder is sustained inside the cupola. The buckets referred to will contain a 30-cwt. charge and weigh 13 cwts. when empty. Regular charging is claimed, together with less handling of materials and reduced labour costs.

Facing Sand

Assuming the good workmanship of the moulder, the preparation of the facing sand to be used is just as vital a factor in foundry practice as the portion so far dealt with. Many foundries still retain the old type of edge runner mill with the heavy rollers resting upon the bottom of the pan; it is very useful for breaking brick, etc., but not altogether satisfactory for the preparation of sand for efficient moulding purposes. The crushing of sand grains is not conducive to good castings, as an increase in the silt content causes scabbing and blow-holes, due to the lack of venting properties in the sand. The action required is kneading or milling, and this can best be obtained by having light rollers and suitable scrapers. The rollers should be off the bottom and have a vertical movement, with a consequent riding effect.

A great deal of controversy exists about the length of time facing sand should be left in the mill, and it is often said that if it is left in for more than a few minutes, scabbing will occur owing to the closeness of the mixture. This may be so when the heavy rollers are used, but it has actually been proved by experiment that the permeability of a sand decreases slightly at 5 minutes' milling, and increases in strength and permeability up to 10 minutes, if milled under ideal conditions. It may be argued that the cost of extra milling would be prohibitive, but this would be more than compensated for by the fact that more black sand could be used with less new sand.

Action of Coal Dust in Facing Mixtures

The most important result is that coal dust has been found to decrease the permeability of a sand, but is instrumental in forming a gas cushion between the mould surface and the molten metal, and in this way is certainly beneficial. It has been discovered that the use of coal dust helps to allay the effects of unsuitable sand, high-water content and bad-milling practice, and on those grounds may be considered a necessity. It is quite possible that foundries operating without coal dust are using sands which are of such quality and have received such treatment that they are exactly suited to the work, and that other foundries, owing to the economic factor, are using sands not exactly suitable for the class of work which is to be made in them. It should not be assumed that foundries using coal-dust facings are necessarily neglecting their sand preparation, but it is a fact that good results can be obtained without it in certain cases, and it opens up an interesting point for further research, and one wonders if the facings of the future may be entirely devoid of coal dust as it is known to-day.

With reference to the size and quality of coal dust used, it is generally agreed that this should not be coarser than the sand with which it is mixed, and that the maximum amount should be 12 per cent. for the thickest of castings. Percentages above this figure give no improvement at all, and may even damage the surface of the casting.

Synthetic Sand

The use of synthetic sand is not usual in this country, or even in America, but certain firms are utilising it, and one or two firms in the U.S.A. use it, it is claimed, with considerable savings, owing to the elimination of new sand. The shop sand is treated with clay and another very fine natural clay called Bentonite, in small percentages, and as uniformly and intimately as possible. A variety of tests have to be taken regularly, both in the foundry and the laboratory, as it is essential, of course, to ensure that the finished mixture is thoroughly homogeneous. The author was very surprised at the "state" of the sand being carried along the rubber-belt conveyor to the hopper at a works he recently visited, but he was assured that this was disintegrated when passing through the sand-slinger into the mould. The foundry manager advised the author to keep off synthetic sand, as infinite care and experience are necessary to ensure successful working.

Oil-Sand Cores

One of the most interesting facts about this practice is the superiority of linseed oil over all other materials for the production of strong cores in the dried state. Unfortunately, linseed oil and sand mixtures have a very low green-bond strength, and to obtain more strength in this state it is necessary to make additions of molasses, resin, etc. These are not usually added in the foundry, but are purchased as core compounds from the many firms now producing these oil-sand preparations.

Sea sand, which is the most popular sand used with oil compounds, must be dry, but not hot, when the compound is added. Moisture prevents the oil coating the sand grains, and warmth sets up reactions which tend to destroy the bonding properties.

The drying of an oil-sand core is not the simple action of expelling water, as in the case of drying an ordinary sand core. Oil-sand cores derive their strength by the oxidation of the constituents of the linseed oil, the oxidation forming a resinous compound, which is the reason for this. Consequently, the air in the actual drying stove should not pass over the fuel supplying the heat, as the oxygen, so necessary in the drying, is partly absorbed, and so prevented from doing its share of strengthening the core.

A temperature of 280 deg. C. appears to be the best temperature for drying oil-sand cores, and at this degree of heat, maximum strength should be obtained. The latest and best type of oil-sand core-drying stove appears still to be the coal-, coke- or gas-fired unit, so arranged that cold air from a fan passes over the firegrate and then into the stove, being admitted at various points at a high temperature. The electric furnace, so far as the author is aware, has not been perfected for this particular purpose yet.

Core-Blowing: Albertus Machine

The most interesting core-blowing machine the author has seen is at the Singer works in Glasgow. The sand used was Belgian white sand mixed with Foundrite, and the cores they were making were for the sewing-machine arm—quite a tricky piece of work. The sand was blown in at a definite pressure through nozzles specially sized for the corresponding inlet in the ends of the core box, half of the core being blown from one end and half from the other. Any wires or springs necessary were pushed into position after the core was made, and the core was then placed in a specially-made carrier to be dried. Cores were made by this means at the rate of just over three a minute, and were excellent. When it is considered that one core would take 15 to 20 minutes to ram up loose, the real success of blowing for mass-production purposes will be realised.

The Singer Foundry

The normal full strength of the factory is approximately 26,000 sewing machines a week, meaning a foundry output of 200 tons per day; 110 tons were cast on the day of the author's visit. The Kilbowie hydraulic machine for the production of castings from double-sided metal pattern plates was very interesting. The pattern plate (in this instance 12 in. by 12 in.) is mounted on a swinging arm, which is moved away from operating centre, where both halves of mould are squeezed or compressed. Two men were averaging 450 snap flask moulds a day; they did their own pouring, own sand preparation and own knocking-out, usually finishing about 3 p.m. in order to start preparation for the next day. There was no conveyor system here for these particular machines (up to six in number), and, considering all the sand was man-handled, the production was very remarkable. The addition of a hopper to each machine, and the consequent saving in time effected, would make the results even more remarkable. No cores were required for the moulds being made, and wheels and similar castings were leaving their own wherever possible.

The process for the moulding of the sewing-machine arms consists of the utilisation of four plates—two tops and two bottoms, one top plate and one bottom plate being arranged side by side around a large jolt squeeze machine. There was one man to each plate, who obtains his sand from a hopper, which is supplied by self-contained sand-preparing apparatus. Each half-mould is swung towards the centre, where the sand is compressed and pattern drawn. The bottom mould is placed on a roller conveyor, where the four cores (collected from overhead travelling trays) are placed in position. The cope is added, and the complete mould is pushed to the pouring site along the conveyor. After pouring, the box is carried to the knocking-out area, where sand and castings are separated, the sand going back to the mixer, and the castings taken away in large barrows.

The sand used was the usual natural sand, and the complete unit was capable of 10,000 castings a week.

Another interesting feature seen in these works was the utilisation of rolled drags where the pattern is nearly all in the cope, and very little in an otherwise "flat" drag. The method consists of making all the drags for 15 to 18 boxes in one long parallel path, and instead of the boxes being in units, there are no divisions, and the appearance of the bottom parts before the copes are positioned resembles a well-rolled garden path. "V"-shaped slides and pins are used, and these are, of course, placed at definite fixed positions along the "path" sides. The length of drag is not rammed, but raked and then rolled by means of a flanged roller, the flanges of which fit accurately over the edge of the drag box or path sides, as it were. Any small facings in this drag were positioned by means of templates. The copes were made on squeeze machines by one man, a labourer producing the drag. The lavatory accommodations in these works were fitted with shower baths and general changing rooms, and were very much appreciated by the men.

Ford's Works

With reference to Messrs. Ford's works at Dagenham, the following notes may prove of interest:—Here is a highly mechanised foundry, which on approach did not look like a foundry at all. The main moulding "bays" consist of three parallel stretches, each fitted with a conveyor system, alongside which are placed at intervals jolt turn-over machines, working in conjunction with sand-slingers and hoppers on revolving tables. These tables were made on the grid principle, and any surplus sand falls through, and is picked up on an underground belt arrangement, which carried the sand to an overhead sand-preparing plant.

Chief interest was taken in the moulding of the 8-h.p. car cylinder block. The drag was made first by means described above, inspected and placed on the conveyor. The mould then travels along slowly, and is skin dried with a paraffin blow-lamp. From here it passes along by core-making areas so planned that the cores were made in the rotation they were required for placing in the mould. The cores were made, in some cases, by small jolting machines, and in others were "blown," on the same lines as the Singer arm-core. The sand used was sea sand, and the bond linseed oil and molasses. The dried cores were not blacked, but coated and painted with liquid flour, which was claimed to be much superior.

The jolt machines used did not appear to be superior to other machines of similar type.

Continuing the process of moulding the cylinder block, the cores all being in position and inspected again, the drag arrives at the position where the cope is made, on similar lines to the first-mentioned operation. The cope is placed in position, runner bushes added, clamps fixed, and the mould is then poured.

The use throughout of synthetic sand was interesting, but one wonders at the necessity for this, with good quality Erith sand about a mile away. The finish on all the castings, although eminently satisfactory, was not superior, in the author's opinion, to those obtained by the ordinary foundry practice of milling and mixing well-known sands.

Scientific Aid

The cupola was charged by hand through a double door. Two 6-ft. cupolas were melting 180 tons per day—one cupola being used solely for the blocks. At thirty per cent. steel was used, but the pig-iron percentage was high in the charge. A chemist stood on the charging platform superintending the weighing of the charges, and in addition to this man there was a charge-hand. Another charge-hand and chemist stood at the tapping hole, taking samples of iron specially prepared, and tested by means of dipping and chilling. The iron in the cylinder block was rejected if it did not show a Brinell of between 185 and 210.

Pig-iron trucks and coke were hoisted from floor level to the charging platform, and all pigs were broken in halves on a "V"-shaped block, in spite of the large-diameter cupolas. Sixty men in all were engaged in the cupola gang. The stone-bricked floors in the foundry between the conveyor systems were at all times kept scrupulously clean, and this was a very marked feature. The cupolas were aluminium paint-coated, and the temperature of the metal 1,500 deg. C. at the spout.

Charge-hands were very numerous, and each operation seemed to have an overseer. It was stated that the percentage wasters on the blocks was 5 per cent., and the metal-to-coke ratio in the cupola 8 to 1, excluding the bed.

Alloy Cast Irons for Special Purposes

Experimental work has been carried out for some time on heat-resisting irons for special purposes, and the results of these tests show that the increase in the silicon content to 6 or 7 per cent. has a marked beneficial effect in increasing the heat-resisting properties and the resisting of corrosion generally, provided the total carbon content is kept reasonably low, say 2 per cent. The experiments proved that as the silicon content is increased to 4 per cent. the growth increased, but with still higher silicon content of over 4 per cent., the growth in iron, having not too large graphite flakes, decreases to a very small figure.

This beneficial effect of a high silicon content is partly due to its action in raising the critical point, and consequently in this respect the property of increasing the resistance to oxidation is produced. The raising of the silicon content is so effective that growth and scaling may be reduced to negligible quantities, even under the most severe service conditions, provided that the silicon is sufficiently high and that the iron is made in such a way that oxidising gases cannot penetrate below the surface via large graphite flakes, gas holes or cracks.

It should be pointed out that these irons become increasingly brittle as the silicon increases, and are not suitable for service conditions where there is constant rapid heating and cooling, since under such conditions they are liable to crack. Further experiments lately have produced a grey cast-iron containing about 18 per cent. nickel, 6 to 7 per cent. silicon, 2 per cent. chromium, 1.8 per cent. total carbon and 1 per cent. manganese, which is exceptionally resistant to growth and scaling, and is also remarkably ductile. For this reason it is not liable to cracking on sudden heating and cooling, which was the defect of the iron mentioned above. It is similar in certain respects to "Ni-resist," a corrosion- and heat-resisting cast iron containing nickel, chromium and copper, recently developed in America. The chief difference lies in the higher silicon content of the iron under discussion. The iron can be melted in the cupola, and there is no difficulty in obtaining total carbon contents as low as 1.8 per cent., since the 4.3 per cent. eutectic carbon of ordinary iron is reduced by the presence of 6 per cent. silicon and 18 per cent. nickel to about 2 per cent. carbon. The iron solidifies at about the same temperature as low-phosphorus, high-quality grey iron, but requires more feeding since the graphite content is lower. It can be run into sections less than $\frac{1}{8}$ in. thick, and such sections can be cast free from white iron. It is easily machinable, giving a fine surface finish, and has excellent corrosion-resisting properties, which are slightly improved by the addition of copper, as in the case of the American iron.

The liability of cast iron to growth is largely dependent on the size and number of the graphite flakes in the structure (incidentally the present iron owes a considerable part of its growth resistance to its low total-carbon content), consequently the graphite structure should be as fine as possible, particularly in thick sections. This may be obtained by reducing the total carbon, or increasing the chromium, or by the careful additions of steel to the melt. Reducing the total carbon or graphite, however, reduces the casting properties, and increases the tendency to solidify white in thin sections, and for most purposes a total carbon of about 1.8 per cent. gives the best results.

In order to obtain good machinability, a nickel content of 18 per cent. is necessary when no chromium is present, but this can be reduced to 13 per cent. if the chromium is present to 1.8 per cent. If easy machinability is not so important, the chromium content may be increased, and this increases the heat-resisting properties and hardness, and although with 5 per cent. chromium the irons are becoming mottled, they are still machinable with high-speed tool steel.

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The silicon should be as high as possible in order to obtain the best resistance to growth and scaling, but should not exceed 6 per cent. with 20 per cent. nickel, or 7 per cent. with 16 per cent. nickel, otherwise free silicides will be present, and will cause loss of ductility and machinability. This metal has proved useful in the manufacture of furnace parts, moulds for glass and for metals, case-hardening pots and internal-combustion engine parts.

Desulphurisation of Cast Iron

Sulphur has always been one of the bugbears of the foundry, and so stringent are the specifications demanding a low percentage of this impurity, that great endeavours have been made of late to eliminate it from inclusion in the casting, whether it be cast iron or steel. Even when the amount of sulphur in the pig-iron is low, there is always the amount in the coke and the scrap (which is sometimes high) to be considered, and for these reasons extraordinary care has had to be taken in the choice of these productive materials. Mn should not be less than 1.7 times S + 0.3 per cent. Mn. If the S = 0.1 per cent., then Mn should be 0.47 per cent.

It used to be stated that if the manganese content was about 0.7 to 0.8 per cent. in the casting, the founder could rest assured that any damage due to sulphur was non-existent. The reason for this is, of course, that when the manganese is less than 0.5 per cent., some of the sulphur may be present as iron sulphide, instead of sulphide of manganese, which is insoluble in molten cast iron and passes into the slag. Sulphur present as sulphide of iron causes trouble, and the use of powdered soda ash (Na_2CO_3) in the process not only allows the foundryman to be less particular in his choice of materials, but it purifies the molten metal to the remarkable extent of 50 to 60 per cent. reduction in the sulphur content.

In ordinary foundry practice the desulphurisation is effected by placing about 20 lbs. of soda ash to a ton of metal in the bottom of the ladle, and tapping the metal as hot as possible on to it. A vigorous reaction between the metal and the alkali takes place, with the rapid evolution of CO_2 and the formation of sodium sulphide, a salt which is the combination of the sodium of the soda ash and the excess sulphur in the ladle iron.

The more or less turbulent reaction ensures the alkali coming into contact with the whole of the ladle contents, and the slag collects on the surface as a thin layer. Ground limestone is then thrown on to this, rabbled in, the slag thickens and is then raked off. The characteristic smell of sulphuretted hydrogen, when the slag is cooled with water, shows that the soda ash has done its work. The total cost works out at about 1d. per cwt., and should not interfere, to any great extent, with the ordinary foundry routine.

With reference to the refractory linings of the ladle, these are attacked slightly by sodium compounds, and it is good practice to coat the surface with blacking or some carbonaceous material to prevent the formation of sodium silicate, or the eating away of the lining.

The effect on the cast iron in addition to the desired lowering of the sulphur can be summarised as follows:—(1) The manganese is not appreciably affected, but there is a slight loss of silicon, which can be corrected, if necessary, by the addition of some high-silicon pig or ferro-silicon; (2) the reduction in sulphur is considerable even when the original amount in the scrap and coke is low; and (3) the process improves the physical properties of the metal. The soda ash has a degasifying action, and greatly reduces the number of the non-metallic oxides in the finished castings. The inclusions of manganese sulphide and ferrous sulphide are destroyed by conversion into sodium sulphide, which passes into the slag.

Testing Cast Iron with Reference to X-Ray

Engineering castings are ordered to certain rigid specifications entailing examination and testing, both mechanical and analytical. Such may include tensile, compression, transverse, deflection, shear, torsion, hardness, impact, chemical composition, and for some purposes corrosion tests, which may all be considered as scientific refinements, and all of which have contributed to whatever progress has been made in the industry, and to which those who follow it are greatly indebted.

Admittedly all these tests applied to samples of the material are useful for determining the physical and chemical properties such samples possess, and give a good idea of the general characteristics. The microscope is also a most useful and necessary adjunct in such investigations, as it gives a true indication of the condition in which the various elements exist either as such, or combined one with the other or others—in other words, chemical analysis reveals the average composition of the mass operated upon, but the microscope analyses and reveals the conditions as they are.

A casting is good or bad just in proportion or relation to the amount of criticism which it has to withstand or the standard of comparison to which it has to conform. This being so, it is only reasonable to conclude that the best castings will be produced by those who possess the best knowledge of foundry technique, and whose plant and equipment have been modelled in accordance therewith.

None of the tests so far mentioned can be applied to a finished casting in order to ascertain its freedom from defects, which may consist of blowholes, contraction pulls, etc., which, if present, would be sources of weakness. However, by means of X-ray examination it is possible to detect such defects in sample castings, with a view to eliminating them in the main supply.

It would be impracticable to apply X-ray testing to every casting as a routine test, but when composition moulding and melting were under proper control for a new type of casting, valuable information might be obtained by means of an X-ray examination in the preliminary stages of the production, to ascertain whether the method adopted was likely to produce a casting free from defects. If the examination reveals defects in the sample or pilot casting, opportunity would be taken to correct the method so that a sound casting could be produced before the method to be adopted for large-scale production were finally decided upon.

This is a great step in advance, and will enable one, with proper adjustment, to examine the interior of a casting without destroying it, but the plant is, of course, an elaborate and expensive one.

(*Concluded from next column*)

The danger does exist, but it will probably be resisted, for, as suggested above, the copper mining industry has during the slump period been forced to the very edge of the precipice, and another spell with the quotation at 5 cents would almost certainly bring ruin to many properties, which would be compelled to close down with no prospects of reopening. That this will be avoided at all costs we may rest assured.

Stainless Steel in India

It appears that the proposals for the manufacture of stainless steel from Mysore iron and Mysore chrome ore are likely to materialise in the near future. With a view to conducting large-scale experiments in the manufacture of this metal, 20 tons of chrome ore have been sent to England. If these experiments are successful, the Mysore Iron & Steel Works will take up the manufacture.

Brighter Copper Outlook

By "Onlooker"

In spite of the fact that the copper producers in America have not been able to compose their differences to the extent of arriving at a satisfactory basis for the signing of the code written for their industry, the prospects for the metal itself appear to be brighter than for some time past. To some extent this is due to an increased usage of the metal, the purchase of which is becoming more and more a matter of long-term contracts and often creates the impression that buying on the open market is at a low ebb, but, consumption apart altogether, there is to-day an increasing disposition to regard copper as a good lock-up investment.

On the Stock Exchange we find that the shares of copper-mining companies are being bid up and firmly held, while from time to time during the past few months there has been something approaching a boom in the Rhodesian section, for costs in this field are known to be abnormally low and, with enormous ore reserves available, the future is very bright. During the slump period copper has suffered probably as much as any commodity, and the year 1932, with an average price below 6 cents, although terribly trying, compelled such a drastic cutting of costs by way of an overhaul of production methods that the industry as a whole is now in real fighting form and ripe to take its place in the van of the movement towards better trade. After all, there is nothing like a dose of adversity for putting people on their mettle!

One imagines, however, that most people connected with copper hold the opinion that it is time the clouds rolled by, and with the quotation standing at 8 cents—paper cents, it is true—there is just a glimpse of that silver lining for which the world has been searching for nearly five weary years. Stocks in the United States are, it is true, still exceedingly heavy, but they are being reduced by degrees, and, what is more important the producers, both primary and smelters, are fully alive to the dangers of the situation. This is reflected in a policy of keeping production down to the lowest level commensurate with keeping the wheels of the industry turning, and although latterly the intake of scrap at the customs plants has rather lifted the monthly rate of output in America, this is a passing phase and is not likely to jeopardise the statistical position.

Outside the United States stocks of copper are, if anything, below normal, and it is notorious that consumers the world over are operating with their cupboards bare, but one cannot close one's eyes to developments in the very near future. Code or no code, it is unlikely that production in the United States will be increased, for the copper people find the present price quite lean enough, and they are hardly likely to take any steps calculated to depress the quotation to a point somewhere below 8 cents. The formation of the United States Copper Association would, it was hoped, help to iron out those differences which lie between the custom smelters and the primary producers, but progress so far towards this desired end has been pretty slow; however, further deterioration of the statistical position in America is unlikely. In other directions the outlook is more obscure. Following on a demand for nickel, which during the past few months has been remarkable, the International Nickel Company announces plans to increase production at the Copper Cliff refinery. Building will presumably be pushed forward rapidly, but the additional tonnage of copper will not be thrown on to the market before the late autumn. Can the consuming trades absorb this, and is there not a danger that other copper producers may be tempted to follow this lead?

(*Concluded in previous column*)

XUM

High-Frequency Electric-Furnace Production

MARKED INCREASE IN INGOT SIZE

Important developments have been taking place in connection with the production of steel in the high-frequency electric furnace. Hitherto, ingots of less than 2 tons in weight only have been produced, but Samuel Fox & Company, Limited, Stocksbridge, Sheffield, associated with The United Steel Companies, Limited, have made a definite step forward by producing 2-ton ingots as shown in our illustration.

It is now generally known that the high-frequency electric furnace is used for the production of special alloy steels of the highest possible quality and purity which formerly were made by

Ingots Cast from High-Frequency Electric Furnace.

the crucible process. With the use of the high-frequency electric process there is no pick-up of impurities and the freedom from non-metallic inclusions renders the process particularly suitable for the production of alloy steels used for machines with highly-stressed parts.

In their furnace at Stocksbridge, Samuel Fox & Company, Limited, have made many experiments with various qualities of steel and reports on tests have been very satisfactory. To widen the application of the use of the high-frequency electric process, this firm is at the present time installing a furnace capable of producing ingots of 5 tons weight.

Steel Spigot and Socket Pipes

The British Standards Institution has issued a British Standard Specification for steel spigot and socket pipes and specials for water, gas and sewage which applies to lapwelded and weldless pipes and specials of nominal sizes from 2 in. to 72 in. inclusive; its requirements are applicable to pipes with flange joints, flexible joints, or the like, except with regard to the joint. It does not apply, however, to what are commercially known as gas, water and steam tubes, which have screwed joints. Four thicknesses are standardised for each size of pipe and the test pressures vary, according to the diameter and thickness, from 500-ft. head for the thinnest of the large-diameter pipes to 2,300-ft. head for the smaller pipes. A special series of pipes, which are interchangeable with cast-iron pipes to the British Standard Specification No. 78 is also standardised. The actual shapes of the sockets have not been standardised, but for each type of joint dealt with the dimensions necessary to secure interchangeability and an adequate caulking space are laid down. The specials standardised are collars, bends and trees. The clauses of the specification deal comprehensively with the quality of the steel and the manner of taking samples for mechanical testing, workmanship and tolerances on dimensions, whilst protection against corrosion is dealt with in sections providing for coating, external covering with hessian or asphalt, and lining with asphalt or concrete. Copies of this specification (B.S.S. No. 534—1934) may be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1. (Price 2s. 2d. post free.)

Blast-Furnace Tuyeres

The making of castings where jackets are the chief characteristics requires much forethought if one is to produce them economically. Generally speaking, outlets for use as coreprints are rare and of small dimensions. Where core-irons are a necessity, they should be constructed so that they are readily withdrawn after casting. The old-fashioned way of breaking cast-iron grids is to-day considered rather crude.

In the illustration, A is a standard type of tuyere: two of the soles shown are used for

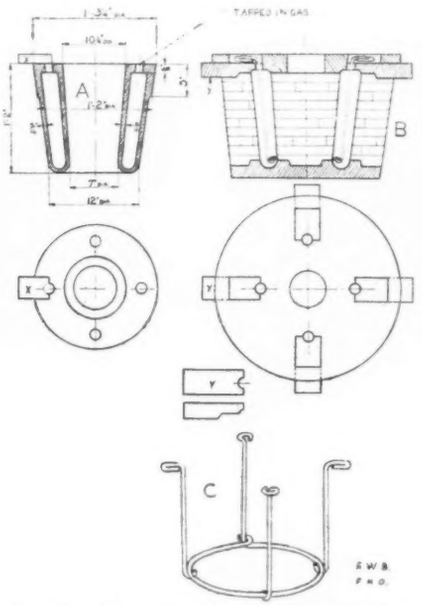


Fig. 1.—Moulding Details for a Blast-Furnace Tuyere.

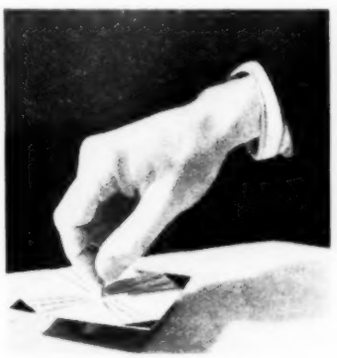
water circulation and two for foundry convenience, the latter after removal of core being tapped and plugged. The tuyeres are cast with four ear prints (one is shown in position at X), and may be cast with the prints at the top or bottom of the mould, whichever is preferred, both ways being successful. B shows the corebox, which needs no explanation (note the loose pieces Y under ear prints). C shows the way of making core iron; this is $\frac{3}{4}$ wrought-iron wire and one can see at a glance how easily it is extracted after casting. In extracting the core alone this method gives 80 per cent. more output. There are no grids to make, break or extract, and the wire is practically everlasting.

Nickel Additions and Inoculated Irons

Mr. S. E. Dawson, referring to the discussion of the lecture presented by Mr. Hurst in Newcastle recently, points out that his remarks, as printed in our issue of February 22, were not quite correct. He states that he had said that with regard to the high strength effect of nickel, and shown on curves which were thrown on the screen, that these figures related to so-called inoculation from a white iron, and were not the direct outcome of adding nickel to a grey-cast iron. To this, Mr. Hurst readily agreed, as reported later on in the discussion. Mr. Dawson does not wish it to be thought that he said that nickel did not add strength to cast iron, even when added in the ordinary way as a pure addition element, in fact on the contrary, it has a decided strengthening effect under these conditions, but he thought it well that it should be made quite clear to the audience, that the figures they had seen related to inoculated iron by nickel, when, as is well known, very high strengths are producible. Such irons are, of course, not austenitic, and reference to this structure of iron was in another connection.

Some Interesting Experiments

When our morning mail included a stout kraft envelope with a mysterious bulge, we put all other letters aside to examine its contents. There was a top to assemble and spin, a barred roof truss for a house and a cellophane-covered sight-testing card. Naturally, being inquisitive, we had to learn how to use them. Then we consulted the enclosed pamphlet, "Test your own lighting." The results of our experiments were extremely interesting, but beyond saying that we were not satisfied with existing conditions, we will not go into details. This testing kit was sent to us by the Benjamin Electric, Limited, Tariff Road, Tottenham, London, N.17, and the covering letter promised to supply our readers with similar sets (No. 15) on the receipt of a letter. As we have visited so very many indus-



Light-Testing Kit (No. 15)

trial establishments, we are aware of but few that would not be improved by acting on the results obtained from a systematic study of their lighting conditions, and we suggest that advantage should be taken of the offer made to our readers.

Nickel-Chromium Cast-Iron Rolls

Cold rolls of chilled cast iron, containing from 3 to 5 per cent. nickel and from 0.5 to 1.5 per cent. chromium have given excellent results in the sheet and tinplate mills of a Japanese steelworks. The ordinary chilled-iron rolls previously used had to be sent back to the lathe for re-turning after only a week's work with six hours' continuous operation each time, whereas the nickel-chromium cast-iron rolls were usable, without re-turning, for 40 or 50 days with 20 hours' continuous operation each time.

Brighter Refractory Prospects

In the course of his annual survey of trade prospects, Colonel Stein, of Bonnybridge, said that while the works were still far from being well employed they had exactly one hundred more workers than at the same time last year. The last two years had been the worst they had experienced, but the iron and steel industries were certainly busier now, and the prospects for brick manufacturers were altogether brighter. It should be kept in mind, however, that until trade throughout the world had recovered they were not out of the wood. It still remained true that the United Kingdom must export manufactured goods and coal to pay for the food that had to be imported. It had been hoped that the International Economic and Monetary Conference held last year would enable a fairly quick recovery to be made if nations had only been able to stabilise currency and come to terms over the other hindrances to trade such as war debts, quotas, etc. He gave an example of the difficulties put in the way of export by quoting Italy, formerly a large market, but now closed to Scottish manufacturers, because of an import duty on firebricks of no less than 48s. 5d. per ton. That was equivalent to about £9 10s. per thousand on 3-in. standard bricks. In view of the failure of the World Conference for which failure we in this country were not responsible, we were now endeavouring to rebuild our export trade by making trade agreements with individual countries, and, while that would take time, it seemed the only satisfactory way in the circumstances, and steady progress was being made.

XUM

This Week's News in Brief

Trade Talk

THE MEMBERS OF Messrs. Colvilles, Limited, Dalzell Steel Works Ambulance Section, held their annual social and dance in Motherwell on February 24.

MR. T. BIRKETT, general manager of the Midland Electric Manufacturing Company, Limited, has been elected to the board in place of Mr. Bernard D. F. Docker, who has resigned his directorship.

THE DISMANTLING DEPARTMENT of Messrs. Stewarts and Lloyds' electrical staff at Mossend held a smoking concert on February 23. Mr. A. Docherty presided.

THE STAFF OF Coltness Iron Company, Limited, Newmains, held their annual whist drive and dance on February 23. Mr. W. H. Telfer, managing director, presided over a large company.

A STONE-CUTTING, MOULDING AND POLISHING MACHINE, the smallest of its kind in the world, has been ordered from the Anderson-Grice Company, Limited, by Mr. Jack Hulbert, the British actor.

THE SHOTTS IRON COMPANY, LIMITED, have relighted another blast furnace, bringing the total in blast to three, in order to meet the largely-increased demand for Scottish pig-iron. The furnace just started is the largest and most modern type at Shotts Works.

MESSRS. HENRY ROBB, LIMITED, Leith, have secured an order to build a steel-screw steamer of 1,600 tons for service in Australia from the Wallarah Coal Company, London. The vessel, which will be 230 ft. long, will be fitted with triple-expansion engines. Messrs. Robb have also contracted to build two steel lighters for Messrs. Lynch Bros., Limited, London.

FURTHER ORDERS have been placed for new vessels on Tyneside and Clydeside. Through the China Purchasing Committee in London, the National Government of China has placed orders with Messrs. Swan, Hunter & Wigham Richardson, Limited, Newcastle, and with Messrs. Barclay, Curle & Company, Limited, Glasgow, for two vessels each. The total contract amounts to about £400,000, and each ship will be about 3,200 tons deadweight.

A DIFFERENCE regarding the working of the eight-hours' shift system in Scottish steelworks has arisen between the Iron and Steel Trades Employers' Association and the Scottish Iron and Steel Trades Joint Committee, which comprised the trades unions representing the boilermakers, blacksmiths, engineers, electricians, patternmakers and foundry workers. The parties have agreed to refer their difference to the Ministry of Labour for settlement by arbitration.

THE SECRETARY of the Scottish Steelmakers' Association has announced that the Etna Iron & Steel Company, Limited, Motherwell, and the Motherwell Iron & Steel Company, Limited, have entered into arrangements with the Scottish steelmakers under which they have become parties to the British steelmakers' rebate scheme as from March 1, 1934. The firms will accordingly, until further notice and subject to the terms of the scheme, pay rebate at the rate of 15s. per ton for plates and sections in respect of all deliveries of rebateable materials against sales made or contracts entered into by them on and after March 1.

AT AN INQUEST at Derby recently, on the body of Percy Mace, aged 29, a foundry labourer, who was trapped inside a foundry oven and asphyxiated, the jury found that death was accidental, and was caused by some unknown person shutting the door. The accident happened in an oven at the works of the Combustion Engineering Company, and Mace's body was badly burned. It was stated that exhaustive inquiries among 30 other employees had failed to show that any of them closed the door when Mace was inside the oven, which he had entered in the normal course of his work. It could only be shut from the outside. The company announced that, as an experiment, they intended to fit a door with asbestos panels which could be easily broken in an emergency.

IT HAS BEEN officially announced that negotiations which have been going on for some time with National Shipbuilders' Securities, Limited, for the sale of the site of Messrs. Napier & Miller's shipyard at Old Kilpatrick to a new firm with a view to starting engineering works and stockyards, have been successfully concluded. Reticence has been observed by all the interested parties during the progress of negotiations, but in the last list of new registrations there is included the name of the firm who have acquired the premises. The company is a private concern styled the Kilpatrick Manufacturing & Exporting Company, Limited, and having as its objects the carrying on of the business of iron-founders, brassfounders, etc. The initial capital is £30,000 in £1 shares.

MESSRS. YARROW & COMPANY, LIMITED, Scotstoun, have received orders for two torpedo-boat destroyers for the Portuguese Government. Although the hulls will be built at Lisbon by the Sociedade de Construcoes e Reparacoes Navaes Lta, all the steel material will be supplied by British makers. The propelling machinery, consisting of Parsons geared turbines developing 33,000 h.p., supplied with steam by three Yarrow water-tube boilers at 400 lbs. per sq. in. fittings, and general equipment, will be constructed at Messrs. Yarrow's works at Scotstoun. Messrs. Lithgows, Limited, Port Glasgow, have received an order to build a passenger and cargo steamer 430 ft. in length and carrying capacity for cargo of 6,500 tons and accommodation for 100 passengers, for the Bombay & Persia Steam Navigation Company, Limited, Bombay. Messrs. Rankine & Blackmore, Limited, who have been without work for some years, will supply the engines and machinery.

TARMAC, LIMITED, of Ettingshall, Wolverhampton, has concluded an agreement with the Lancashire Steel Corporation, Limited, of Irlam, near Manchester, by which the company has been appointed sole selling agent for all tarred and dry slag produced at the Irlam and Wigan works of the Lancashire Steel Corporation. In addition, arrangements have been made whereby Tarmac's bituminous topping, "Settite," will be manufactured at Irlam. Only a few months ago Tarmac concluded an agreement with Dorman, Long & Company, Limited, to become sole selling agent for all dry slag shipped from the Teeside works of Dorman, Long & Company to the Southern and Eastern ports of England. In the Midlands the major portion of the company's supplies are obtained from Stewarts and Lloyds, Limited, who are making extensive additions to their plant at Corby, which will substantially increase the output of slag in this particular area. Supplies for the Eastern Counties are drawn from John Lysaght, Limited, and through the associated company, Tarmac (South Wales), Limited; supplies for South Wales are drawn from the British (Guest Keen Baldwins) Iron & Steel Company, Limited.

Company Reports

C. Akrill & Company, Limited.—Dividend of 10 per cent., tax free, on the ordinary shares for the year 1933.

W. Canning & Company, Limited.—Profit, £52,526; final dividend of 7½ per cent. and a bonus of 7½ per cent., making 17½ per cent. for the year.

Enfield Cable Works, Limited.—Profit, £123,241; brought in, £2,975; depreciation, £11,842; preference dividend, £15,000; ordinary dividend of 20 per cent.; carried forward, £17,974.

Millom & Askam Hematite Iron Company, Limited.—Profit, £35,016; brought in, £54,853; debenture stock interest and redemption fund, £9,303; carried forward, £80,566.

James Booth & Company (1915), Limited.—Net profit, £48,642; brought in, £17,847; preference dividend, £8,400; dividend of 15 per cent. on the ordinary shares; to reserve, £10,000; carried forward, £19,964.

Contracts Open

Cottingham, March 10.—Supply and laying of 4,000 yds. of 6-in., 4-in. and 3-in. cast-iron water mains, for the Urban District Council. Mr. J. H. Haiste, Middleton Chambers, Lowgate, Hull. (Fee £1 1s., returnable.)

Sutton, March 14.—Supplying and laying compressed-air main in spun-iron pipes, for the Sutton and Cheam Urban District Council. Mr. W. Hedley Grieves, surveyor, Municipal Offices, Sutton. (Fee £2 2s., returnable.)

Southampton.—Supply and erection of pumping plant, for the Town Council. Mr. J. Hawksley, waterworks engineer and manager, Civic Centre, Southampton. (Fee £3 3s., returnable.)

Personal

MR. J. BONAS, of 417, Jockey Road, Sutton Coldfield, is shortly returning to India to rejoin his firm, the Britannia Engineering Works, Bengal.

MR. THOMAS BAYNE was made the recipient of a number of gifts from the employees of Durie Foundry, Leven, when he retired after 52 years' service.

MR. AND MRS. JOSEPH CLARK, of Scotia Street, Motherwell, have just celebrated the fiftieth anniversary of their marriage. Mr. Clark was employed for over 40 years with Messrs. Hurst Nelson & Company, Limited, Motherwell, until he retired recently.

MR. PHILIP HOPKINS, J.P., of Stockton, retired recently from the management of the works of the South Durham Steel & Iron Company, Limited, with which he has been associated for 50 years. He was first manager of the old Moor Works, later joint manager with Mr. John Reay at the Malleable Works, and recently at West Hartlepool. Mr. Hopkins is 70 years of age.

MR. WALTER P. CLYDE, who has been managing director for over 20 years of Messrs. Dobbie M'Innes & Clyde, Limited, Glasgow and London, makers of navigation and engineering appliances, retired on February 28. He is a Past-President of the British Nautical Instrument Trade Association and represents the Institution of Engineers and Shipbuilders in Scotland on the British Engineering Standards Committee.

Wills

TAYLOR, FREDERICK, O.B.E., J.P., of Oakwood, Briton Ferry, partner in the firm of Taylor & Sons, Limited, engineers, of Briton Ferry	£4,918
THOMPSON, WILLIAM, of Totley Rise (Derbyshire), chairman of Messrs. Walter Spencer & Company, Limited, Crescent Steel Works, Sheffield ...	£13,743

Obituary

THE DEATH OCCURRED, on March 1, within five days of being 72 years of age, of Mr. Thomas Hardill, of Gladstone Street, Cleckheaton, a director of Wm. Hardill, Sons & Company, Limited, Netherfield Foundry, and a son of the founder of the undertaking.

MR. W. M. MARSHALL, foreman patternmaker with Messrs. Jackson Elphick & Company, Limited, bath founders, Larkhall, died suddenly at his residence on March 1, aged 66 years. He was preparing to start for work when he collapsed and died almost immediately.

MR. WILLIAM MCOWAT died at his residence in Laird Street, Coatbridge, on February 25. He was a director of the firm of Lamberton & Company, Limited, ironfounders and engineers, Sunnyside Works, Coatbridge. Mr. McOwat served his apprenticeship with the firm, with whom he had been for 49 years.

THE DEATH OCCURRED, on February 26, at his home in Constitution Street, Aberdeen, of Mr. William Ross, at the age of 63. Mr. Ross served his apprenticeship as a patternmaker with Messrs. Harper, Torry, and for the past 30 years was patternmaker with Messrs. Bowman & Webster, Limited, South Constitution Street, Aberdeen.

Company Meeting

The annual meeting of Messrs. Mather & Platt, Limited, was held in Manchester recently. MR. L. E. MATHER (chairman of the company), who presided, said that the accounts made a better showing than seemed possible when the year closed, and, while they suffered serious curtailment of production last year, the outlook had distinctly improved. They commenced this year with a larger volume of orders than a year ago, and the month of January was the best they had had for some time. This improvement had enabled them to add to the number of employees and to contemplate starting a permanent night shift. Their home business had shown a small but welcome expansion during the year, though still some way behind the figures of normal years. Overseas, the volume of orders had been practically the same as a year ago; and what they had lost in one market they had gained in another, but prices generally had been deplorably low.

CUMMING'S CFF FOUNDRY FACINGS

Wm. CUMMING & Co., Ltd.,

Ironfounders' Facings Manufacturers and General Foundry Furnishers,

Kelvinvale Mills, Maryhill, Glasgow.

Branches at Falkirk, Chesterfield, Deepfields and Middlesbrough.

The Leading Manufacturers. The Oldest Established. The Most Reliable.

CUMMING'S CCC CORE COMPOUND

SUPERFINE COALDUST

SUPERLATIVELY REGULAR IN GRIST
SUPERIOR IN QUALITY
SEVEN GRISTS STANDARDISED
ONE QUALITY OF COAL THROUGHOUT

IMPROVED INGOT MOULD BLACKING

THE BEST ON THE MARKET
MANUFACTURED BY THE NEW PROCESS

BRITISH PLUMBAGOS

AT LOW PRICES
IMPORTED DIRECT
NO CONTINENTAL ADULTERATIONS

CORE COMPOUNDS, CUMMINGSTONE, PARTING POWDER, AND BLACKINGS

ALL OF OUR OWN MAKE

USERS OF THE NEW

CUMMING FURNACE

ARE INCREASING WEEK BY WEEK

CUMMING'S CPP PARTING POWDER

Wm. CUMMING & Co., Ltd.,

GLASGOW, FALKIRK, CHESTERFIELD, DEEPFIELDS and MIDDLESBROUGH.

CUMMING'S CRIC RELIABLE IRON CEMENT

Raw Material Markets

Quiet conditions have been recorded in the iron and steel markets during the last week or two, and fuller activity is not looked for until the end of the present quarter is reached. There is only a small volume of hand-to-mouth business passing in pig-iron, the needs of the majority of consumers being amply covered under existing contracts. A noteworthy development has been the issue of new delivered prices for East Coast hematite.

Pig-Iron

MIDDLESBROUGH.—There continues to be a strong demand for Cleveland foundry iron, and the output of the four blast furnaces producing for the open market is fully requisitioned. The ironmasters have no reserve stocks, and are furthermore heavily booked over the next few months. All the makers firmly adhere to the fixed official prices governing home sales. These are 67s. 6d. per ton for No. 3 Cleveland G.M.B., 70s. per ton for No. 1 foundry and 66s. 6d. per ton for No. 4 foundry and No. 4 forge iron, all delivered Middlesbrough.

A circular was issued to merchants last Saturday detailing the new East Coast hematite quotations (given in full elsewhere on this page). The f.o.t.-at-works quotation has been abandoned in favour of a system of fixed delivered prices in various zones. The new rates are really a reduction on the old, the amount varying in different parts of the country. There was a lull in business previous to the announcement, but activity has now been resumed.

LANCASHIRE.—The volume of new orders for pig-iron from this district has for some time been limited, but the makers are already well committed, and are well satisfied with the rate at which iron is going into consumption here. The general-engineering and light foundries continue fairly busy, but employment at the jobbing foundries still leaves much room for improvement. For delivery to users in the Manchester price zone, current offers of Derbyshire, Staffordshire and North-East Coast brands of No. 3 foundry are all on the basis of 72s. per ton, with Northamptonshire at 70s. 6d., Derbyshire forge at 67s., and Scottish foundry iron at around 85s.

MIDLANDS.—In this district, as in others, there has been a shortage of new business for some time, but the makers are heavily booked and are content to await the coming of the spring demand. The consuming industries in the Midlands maintain their activity well. The Association prices applying to Birmingham and Black Country stations are 67s. 6d. per ton for Northants No. 3, and 71s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, plus 7d. per ton for delivery into works in certain cases. These figures are also subject to rebate for large tonnages. Special irons for engineering work have not advanced from the figures given last week. The demand is improving, because of the slightly better tone of the engineering trade.

SCOTLAND.—The pig-iron market maintains a firm tone, but there has been little buying of Scottish foundry since the increase in prices was made. Prices now stand at 70s. f.o.r. furnaces for No. 3 foundry and 72s. 6d. for No. 1. The light-castings foundries remain busy, and more Cleveland iron has been bought at the new prices, viz., 67s. 3d. f.o.r. Falkirk and 70s. 3d. f.o.r. Glasgow, for No. 3 grade. Other English foundry iron is obtainable at 1s. 3d. per ton below these prices. Another blast furnace was blown-in last week. Out of a total of 13 furnaces now working in Scotland, there are six on foundry, three on hematite and four on basic. Another is expected to be in blast shortly.

Coke

There is a strong demand for foundry coke, and the market maintains its firm tone. Current quotations, delivered in the South Staffordshire area, are as follow:—Best Durham foundry coke, 36s. 6d. to 40s.; Welsh coke, 36s. to 47s.; Scottish coke, 40s. to 41s. per ton.

Steel

Business in the steel markets shows signs of recovering from the quiet conditions that ruled during the greater part of February, and consumers who bought heavily early in the year are again taking an interest in the market, says the official report of the London Iron and Steel Exchange. In the semi-finished steel department the demand has been steady. Most works are well off for orders and are experiencing continuous pressure for delivery. Competition from imported material is not a serious factor in the market, although a certain amount of business is transacted with Continental works, principally by consumers who require this steel for special purposes. After a lull in most departments of the finished steel market, business seems to have revived; but buyers of certain descriptions are still in a hesitating mood. The demand for the lighter classes of steel, however, has again increased. Business in structural steel is irregular, whilst the demand from overseas remains disappointing. The economic obstacles to expansion in the latter direction remain very formidable.

Scrap

There has been a slight setback in the Cleveland scrap-iron market, ordinary cast and machinery metal dropping back to 53s. and 55s. per ton respectively. There is a steady demand for cast iron in the Midlands, where heavy machinery is at 55s., good heavy at 50s. and clean light metal at 47s. 6d., all delivered works. There is a good inquiry for machinery cast-iron scrap in Scotland, at from 58s. to 59s. per ton; ordinary cast iron is quoted at 55s. In South Wales the call for good cast-iron machinery scrap in cupola sizes is very slow, current quotations varying from 47s. 6d. to 50s. per ton. Heavy cast iron, which has a fair demand, is at from 47s. 6d. to 48s. 6d., light cast-iron scrap being a little easier at about 40s. per ton.

Metals

Copper.—A somewhat better tone has been noticeable in the copper market, in spite of the fact that a certain amount of selling pressure from America is still evident.

"Consumers, particularly in this country, have been holding back, encouraged by the free offering of electro to expect lower prices. The possibility that electro will be delivered against sales of standard must not be excluded, as producers of electro appear to be weary of waiting for consumer buying. In some of the Central European countries—where consumers have been under-stocked for some time—there has been a better demand. The low price of copper, and the small contango on carrying it, continue to attract the attention of speculators," report Messrs. Brandeis, Goldschmidt.

The week's prices have been as follow:—

Cash.—Thursday, £32 11s. 3d. to £32 12s. 6d.; Friday, £32 8s. 9d. to £32 10s.; Monday, £32 15s. to £32 16s. 3d.; Tuesday, £32 16s. 3d. to £32 17s. 6d.; Wednesday, £32 15s. to £32 16s. 3d.

Three Months.—Thursday, £32 13s. 9d. to £32 15s.; Friday, £32 13s. 9d. to £32 15s.; Monday, £33 to £33 1s. 3d.; Tuesday, £33 1s. 3d. to £33 2s. 6d.; Wednesday, £32 18s. 9d. to £33.

Tin.—A distinctly firmer market has been seen since the publication of the favourable statistics for February, and on Tuesday the price of standard tin reached £229 17s. 6d. per ton for spot. The figures referred to showed a reduction in the total visible supply of about 590 tons, which was regarded as satisfactory. A further point is that it has been decided to make no change in the production quota as from April 1; a small increase had been thought possible, in view of the fact that there is likely to be some shortage of prompt supplies when consumption expands in the second quarter.

Daily quotations:—

Cash.—Thursday, £228 10s. to £228 12s. 6d.; Friday, £229 2s. 6d. to £229 5s.; Monday, £229 12s. 6d. to £229 17s. 6d.; Tuesday, £229 17s. 6d. to £230; Wednesday, £229 12s. 6d. to £229 15s.

Three Months.—Thursday, £227 17s. 6d. to £228; Friday, £228 7s. 6d. to £228 10s.; Monday, £228 7s. 6d. to £228 10s.; Tuesday, £228 10s. to £228 12s. 6d.; Wednesday, £228 12s. 6d. to £228 15s.

Spelter.—With metal arriving early this month against March contracts in quantities rather surplus to requirements, the market has been subjected to fairly extensive liquidation, and the forward position, moreover, has been depressed by substantial selling. Trade demand being only moderate, the market has received little by way of compensation in this direction, and prices therefore have declined. The situation on the Continent, moreover, has shown little or no improvement, and vague rumours are already busy with the possibility of Cartel difficulties. Confidence therefore has been somewhat disturbed, but at the lower levels the market has shown a little more resistance again, and closes with a firmer undertone, state Messrs. Rudolf Wolff in their weekly report.

Price fluctuations:—

Ordinary.—Thursday, £14 8s. 9d.; Friday, £14 12s. 6d.; Monday, £14 13s. 9d.; Tuesday, £14 17s. 6d.; Wednesday, £14 15s.

Lead.—There continues to be a fair demand for lead in this country, but the demand on the Continent is still limited. A slight improvement has been seen in prices, but this is not likely to go far, on account of the heavy supplies of lead on the market and the number of consumers who are at present holding good stocks.

Daily market prices:—

Soft Foreign (Prompt).—Thursday, £11 7s. 6d.; Friday, £11 10s.; Monday, £11 12s. 6d.; Tuesday, £11 13s. 9d.; Wednesday, £11 11s. 3d.

East Coast Hematite Prices

ZONING SYSTEM ADOPTED

After prolonged negotiations the North-East Coast hematite makers have arrived at an agreement (dated March 2) for the fixation of zone prices which are henceforth to be regarded as the minimum figures for all sales of East-Coast hematite. For this purpose Great Britain has been divided into ten zones in addition to the local area, which embraces Middlesbrough, Stockton, Thornaby, Stillington, West Hartlepool, Guisborough and South Bank. For the local zone the price has been fixed at 68s. for No. 1 f.o.t. buyer's station or siding. It is also specifically provided that merchants are not allowed to operate in the Sheffield area, which is reserved exclusively for makers' direct sales to consumers. With this reservation, the definition of the ten zones and the minimum prices (based on hematite No. 1) to be charged in each is as follows:—

Zone 1.—London, Middlesex, Berks, Hants, Sussex, Kent and Surrey, bounded on the north by a line drawn from Oxford to the East Coast. By rail, 81s. 6d. per ton delivered; by sea, 67s. 6d. per ton f.o.b. exclusive of Tees dues, or 74s. per ton c.i.f. buyers' port.

Zone 2.—Dorset, Devon, Cornwall, Somerset, Gloucester, Wilts, Monmouth, Glamorgan, Carmarthen, Pembroke, Hereford, Radnor and Cardigan (excluding South Wales), 83s. 6d. per ton delivered.

Zone 3.—Lincoln, Huntington, Cambridge, Suffolk, Norfolk, North Essex. By rail, 80s. per ton delivered, by sea 67s. 6d. per ton f.o.b.

Zone 4.—North Buckingham, North Hereford, Bedford, Northampton, North Oxford, Warwick, Worcester, Shropshire, Leicester, Rutland, Stafford, Montgomery and Merioneth. By rail, 79s. per ton in 10-ton lots.

Zone 5.—Lancs (except Furness district), Cheshire, Flint, Denbigh, Carnarvon, Anglesey, 76s. per ton delivered by rail.

Zone 6.—Derby, Notts and South of Yorkshire, bounded by a line drawn due east from the borders of Lancashire, near Bacup, to the Humber, excluding Sheffield area. By rail, 77s. per ton delivered.

Zone 7.—Yorks, north of the line drawn due east from the borders of Lancashire, near Bacup, to the Humber (excluding N.E. local zone), 74s. per ton delivered by rail.

Zone 8.—Northumberland and Durham, excluding N.E. local zone, 70s. per ton.

Zone 9.—Cumberland, Westmorland and Furness district of Lancs, 76s. per ton.

Zone 10.—Scotland, by rail, 75s. per ton delivered; by sea, 72s. per ton c.i.f.

In regard to Zone 1, it is specifically laid down that the price of 67s. 6d. f.o.b. must only be quoted where merchants give an undertaking not to sell below 74s. per ton c.i.f. buyers' port.

In regard to Zone 3, the quotation of 67s. 6d. f.o.b. is subject to the undertaking not to sell below 80s. per ton f.o.t. buyers' station or siding.

THE WALES AND MONMOUTH BRANCH of the Institute of British Foundrymen has arranged to hold an extra lecture at Llanelly on March 24 for propaganda purposes. Mr. E. Longden, of Manchester, is to lecture on "Some Practical Moulding Problems."

for intricate detail

The decorative panel shown here is cast in aluminium-silicon alloy. This illustrates the suitability of aluminium alloys for intricate detail work.

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The BRITISH ALUMINIUM CO. Ltd.
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MORE THAN 100 FURNACES SUPPLIED DURING LAST 7 YEARS.

WATSON ROTATING ELECTRIC FURNACES Ensure RAPID & CLEAN MELTING

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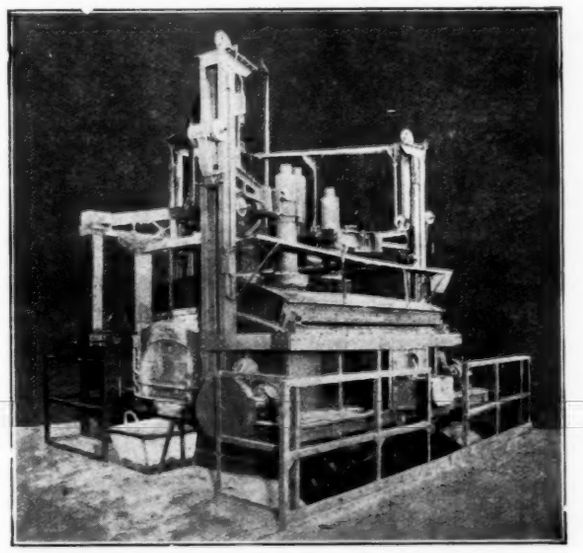

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SINGLE, TWO, or THREE PHASE.

CONTRACTORS TO HOME AND FOREIGN GOVERNMENTS.

WATSONS (METALLURGISTS) LIMITED

Adelaide Works, Mowbray Street, SHEFFIELD, 3.

XUM

RAW MATERIALS—PRICE LIST

(Wednesday, March 7, 1934)

COPPER

	£	s.	d.
Standard cash	32	15	0
Three months	32	18	9
Electrolytic	35	15	0
Tough	34	10	0
Best selected	35	0	0
Sheets	62	0	0
India	44	5	0
Wire bars	36	5	0
Ingot bars	36	5	0
H.C. wire rods	38	10	0
Off. av. cash, February	33	2	1⅛
Do., 3 mths., February	33	5	6
Do., Sttlmnt., February	33	1	9
Do., Electro, February	36	4	8½
Do., B.S., February	36	3	1½
Do., wire bars, February	36	10	0
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	4¼d.
Sheets to 10 w.g.	7½d.
Wire	7¾d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	229	12	6
Three months	228	12	6
English	230	5	0
Bars	231	15	0
Straits	233	15	0
Australian (nom.)		—	
Eastern	231	10	0
Banca	233	15	0
Off. av. cash, February	226	16	2¼
Do., 3 mths., February	226	8	2¼
Do., Sttlmt., February	226	16	3

SPELTER

	£	s.	d.
Ordinary	14	15	0
Remelted	15	5	0
Hard	12	15	0
Electro 99.9	17	5	0
English	15	10	0
India	14	5	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., February	14	19	8¼
Aver. spot, February	14	16	10½

LEAD

	£	s.	d.
Soft foreign ppt.	11	11	3
Empire	11	18	9
English	13	0	0
Off. average, February	11	15	5⅝
Average spot, February	11	12	8¼

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whse.	23	2	6
Rods	29	0	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	39	0	0 to	40	0	0
Chinese, ex-whse.				30	10	0
Crude				20	0	0

QUICKSILVER

	£	s.	d.	£	s.	d.
Quicksilver	10	5	0 to	10	12	6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum— 70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium— 23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten— 80/85%	2/7 lb.
Tungsten metal powder— 98/99%	2/10 lb.
Ferro-chrome— 2/4% car.	£32 0 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome— Max. 2% car.	£37 10 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70%, carbon-free	10½d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium— 96/98%	2/5 lb.
Ferro-manganese (net)— 76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese— 94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	15	0 to	2	16	6
Bundled steel and shrngs.	2	7	6 to	2	15	0
Mixed iron and steel	2	10	0 to	2	12	6
Heavy cast iron	2	7	6 to	2	8	6
Good machinery	2	7	6 to	2	10	0
Cleveland—						
Heavy steel				2	10	0
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	13	0 to	2	15	0
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	0	0
Steel turnings, f.o.r.				1	13	6
Scotland—						
Heavy steel	2	12	6 to	2	13	6
Ordinary cast iron				2	15	0
Engineers' turnings				2	2	6
Cast-iron borings				2	0	0
Wrought-iron piling				2	12	6
Heavy machinery				2	18	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	28	0	0
Brass	20	0	0
Lead (less usual draft)	10	10	0
Tea lead	8	0	0
Zinc	10	0	0
New aluminium cuttings	68	0	0
Braziery copper	26	0	0
Gunmetal	26	0	0
Hollow pewter	150	0	0
Shaped black pewter	105	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/–
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/–
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/–
,, No. 3 fdry.	71/–
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/–
,, fdry. No. 3	71/–
,, fdry. No. 1	74/–
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/–
Hem. M/Nos. d/d	71/–
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	72/–
Staffs fdry. No. 3	72/–
Northants fdry. No. 3	70/6
Cleveland fdry. No. 3	72/–
Dalzell, No. 3 (special)	102/6 to 105/–
Glengarnock, No. 3	85/–
Clyde, No. 3	85/–
Monkland, No. 3	85/–
Summerlee, No. 3	85/–
Eglinton, No. 3	85/–
Gartsherrie, No. 3	85/–
Shotts, No. 3	85/–

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	5	0 to	8	0	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.	13	15	0			
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	5	0 to	9	0	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅝ in. (Untested)				8	12	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)	10	10	0 & up.			
Black sheets, 24g. (4-t. lots)				10	5	0
Galv. cor. shts. (,,)				12	15	0
Galv. flat shts. (,,)				13	5	0
Galv. fencing wire, 8g. plain				14	10	0
Billets, soft				5	10	0
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	5	0
Tin bars				5	0	0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	11¾d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round— to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	13.50
Basic, Valley	17.00
Bessemer	19.76
Malleable, Valley	17.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	26.00
Sheet bars	26.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	1.89
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.35
Plain wire	2.20
Barbed wire, galv.	2.85
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/– to 27/6
,, furnace	18/6 to 19/–
Durham foundry	21/– to 25/–
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/3 to 16/9
,,	28×20 ,,	32/6 to 33/6
,,	20×10 ,,	23/6 to 23/9
,,	18¾×14 ,,	17/– to 17/3
C.W.	20×14 ,,	15/–
,,	28×20 ,,	31/– to 31/3
,,	20×10 ,,	21/6 to 21/9
,,	18¾×14 ,,	15/– to 15/3

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, at'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.	
Mar.	1 ..	32	11	3	No change
,,	2 ..	32	8	9	dec. 2/6
,,	5 ..	32	15	0	inc. 6/3
,,	6 ..	32	16	3	,, 1/3
,,	7 ..	32	15	0	dec. 1/3

Electrolytic Copper

		£	s.	d.	
Mar.	1 ..	35	12	6	inc. 2/6
,,	2 ..	35	12	6	No change
,,	5 ..	35	10	0	dec. 2/6
,,	6 ..	35	10	0	No change
,,	7 ..	35	15	0	inc. 5/-

Standard Tin (cash)

		£	s.	d.		
Mar.	1 ..	228	10	0	inc.	17/6
,,	2 ..	229	2	6	,,	12/6
,,	5 ..	229	12	6	,,	10/-
,,	6 ..	229	17	6	,,	5/-
,,	7 ..	229	12	6	dec.	5/-

Tin (English ingots)

		£	s.	d.		
Mar.	1 ..	229	0	0	inc.	15/-
,,	2 ..	229	15	0	,,	15/-
,,	5 ..	230	5	0	,,	10/-
,,	6 ..	230	10	0	,,	5/-
,,	7 ..	230	5	0	dec.	5/-

Spelter (ordinary)

		£	s.	d.		
Mar.	1 ..	14	8	9	dec.	6/3
,,	2 ..	14	12	6	inc.	3/9
,,	5 ..	14	13	9	,,	1/3
,,	6 ..	14	17	6	,,	3/9
,,	7 ..	14	15	0	dec.	2/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
Mar.	1 ..	16	15	0	No	change
,,	2 ..	17	0	0	inc.	5/-
,,	5 ..	17	0	0	No	change
,,	6 ..	17	5	0	inc.	5/-
,,	7 ..	17	5	0	No	change

Zinc Sheets (English)

		£	s.	d.		
Mar.	1 ..	24	10	0	No	change
,,	2 ..	24	10	0	,,	,,
,,	5 ..	24	10	0	,,	,,
,,	6 ..	24	10	0	,,	,,
,,	7 ..	24	10	0	,,	,,

Lead (English)

		£	s.	d.		
Mar.	1 ..	12	15	0	dec.	5/-
,,	2 ..	12	15	0	No	change
,,	5 ..	13	0	0	inc.	5/-
,,	6 ..	13	0	0	No	change
,,	7 ..	13	0	0	,,	,,

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 6
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4½	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 8½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	99 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7¼
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6½
1924	99 10	97 3½	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2½	81 9	81 9	88 7½
1925	80 4½	78 10½	78 0	78 3	76 0	73 10½	71 7½	69 10½	68 1½	66 7½	66 0	66 10½	72 10½
1926	69 4½	70 0	70 0	70 0	72 6	75 10½	86 7½	90 0	93 10½	117 10	120 0	99 0	86 5
1927	85 0	83 1½	81 0	80 0	73 9	70 0	70 0	68 9	67 6	67 6	66 10½	65 0	73 2½
1928	65 0	65 0	65 6	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	65 9½
1929	66 0	66 9	67 0	68 1½	69 5	71 10½	72 9	72 6	72 6	72 6	72 6	72 6	70 4½
1930	72 6	72 6	70 0	67 6	67 6	67 6	67 6	64 6	63 6	63 6	63 6	63 6	66 11½
1931	59 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 7
1932	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6
1933*	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6
1934*	62 6	65 0	—	—	—	—	—	—	—	—	—	—	—

* Delivered Middlesbrough area. Prior to 1933, prices were f.o.t. furnaces.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

ADVERTISER, well established among iron-founders with travelling Midland Counties and Lancashire, is desirous of selling pig-iron for a blast-furnace company.—Address, Box 654, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

BRASS MOULDERS.—Wanted, one or two skilled (hand) Moulders used to making small and medium cored gunmetal, etc., castings from loose patterns in floor boxes (poured flat), not spilling hearth work. Non-union; piecework; good wages for capable men.—Apply, stating experience, age, etc., to Box 680, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN Patternmaker required for large foundry in Bengal. Applicants should be single, about 30 years, conversant with foundry practice, green, dry, and loam moulding, able control labour and compute material and labour rates from drawings for all classes of patterns.—Reply by letter, with copies testimonials, stating age, married or single, to "STRICKLE," c/o W. ABBOTT, LIMITED, 32, Eastcheap, London, E.C.3.

WANTED, by North of England firm, first-class Foundry Foreman, accustomed to cupola control, modern plate and machine moulding. Salary to suitable man, £6 to £8 per week.—Reply, giving age, experience and previous positions, to Box 682, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOREMAN Patternmaker desires re-engagement. Has had experience in similar capacity with well-known firms making light repetition castings for the motor and electrical trades. Specialist on machine and platework. (238)

PROPERTY

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

PATENT

THE Proprietors of the Patent No. 197,177, for "Improvements in Casting Machines," are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake & Company, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1934 edition now ready. Price 42s. cloth bound, 52s. morocco. Order *YOUR* copy *NOW*.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.

Rotoil "Senior" Oil Core Sand Mixer.

Pneulec Sand Drying Plant, output 1 ton per hour.

Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.

Also

Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.

Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.

'Phone: Broadwell 1359.

THOS. W. WARD, LTD.

VERT. DRILL, A.G., 3½" spin. 12 speeds, 36" swing.

New PNEU. SAND MOULDER, admits boxes 16" x 16" x 6".

BLOWING ENGINE, twin-beam type, 42" cyls., 8' 0" str.

6 Self-supporting MILD-STEEL CHIMNEYS, 150' high x 6' 6" dia.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MISCELLANEOUS

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. 'Phone 264

WORK required for Hardinge Mills and Air Separators up to 250 mesh. Will collect raw material, warehouse, deliver finished product in bags. Very cut rates to keep plant occupied.—HIBBERTS, LIMITED, Octagon Works, Battersea, S.W.11. 'Phone: Batt. 6666.

6 IN. VICES; excellent condition, for sale; large quantity; 30s. each.—Box 684, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

CRANE LADLES

In Stock, Slough; send for List.

ALL Sizes from 10 cwts. to 10 tons.

ALL Ladles warranted; state size required.

ANY LADLE SENT ON APPROVAL.

ALEX. HAMMOND, 14, Australia Road, Slough.

MISCELLANEOUS—*Continued*

GROUND Coke, 200 mesh, 5 per cent. moisture, for sale in paper bags, delivered your works. Cut rates. Large or small quantities supplied.—HIBBERTS, LIMITED, Octagon Works, Battersea, S.W.11. 'Phone: Batt. 6666.

PATTERNS.—Inferior Patterns make trouble in the foundry. Why not buy the best—they cost very little more.—Send to FURMSTON & LAWLOR, Letchworth, Herts.

'Phone: 287 SLOUGH

SANDBLAST PLANTS

12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories **£290 Nett.**

6' × 6' × 8' Tilghman Sandblast room, similar to above, but with B.H.2 Tilghman horizontal compressor: price complete **£130**. Several small Tilghman plants.

6' "Jackman" rotary sandblast table. CHEAP seen working.

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1 **£30**

Rotary Sand Dryer by Titan **£55**

Gyratory sand riddle with motor **£7**

Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*

14, AUSTRALIA ROAD, SLOUGH

WAX WIRE

for CORE VENTING

"ALWYN" Brand

Best British Make.

Sizes $\frac{1}{16}$ to $\frac{1}{2}$ inch

Prompt Delivery. Lowest Prices.

GEO. WINNALL & SON

200/2, Newhall Street, BIRMINGHAM.

Telegrams: Roscommon.

Phones: Central 1711 and 1712.

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed. There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

SCHOOL FOR THE BLIND

(FOUNDED 1838)

SWISS COTTAGE, LONDON, N.W.3